SEVENTY-THIRD YEAR

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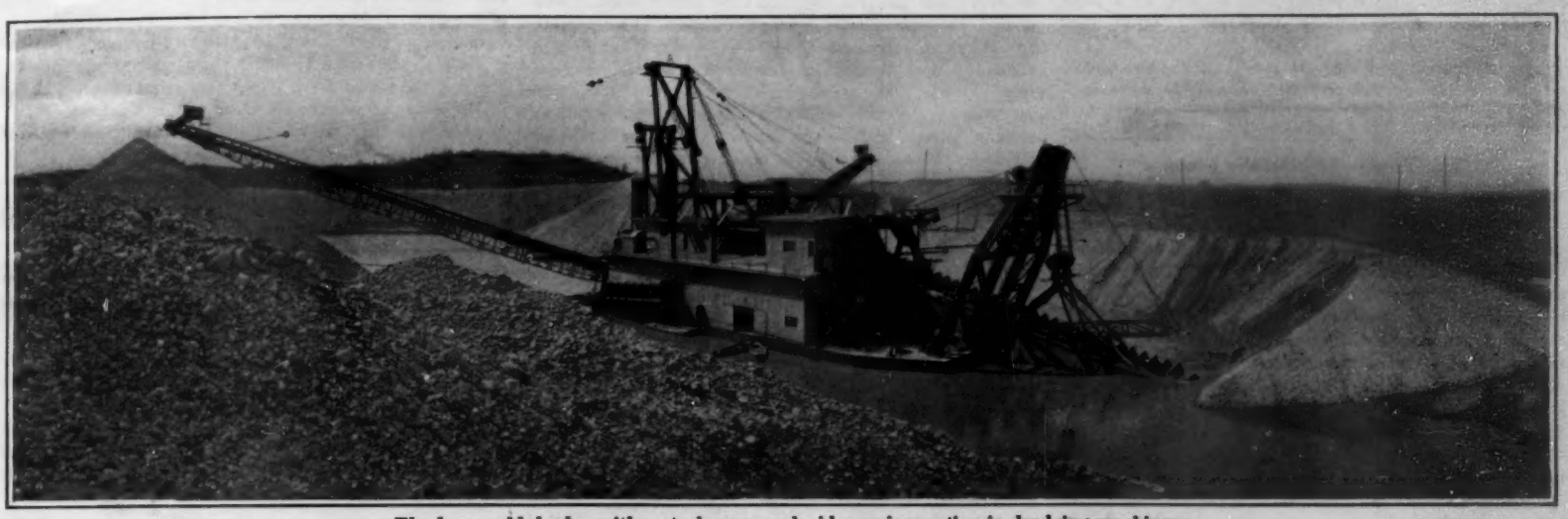


The huge gold dredge with a stacker on each side, an innovation in dredging machinery

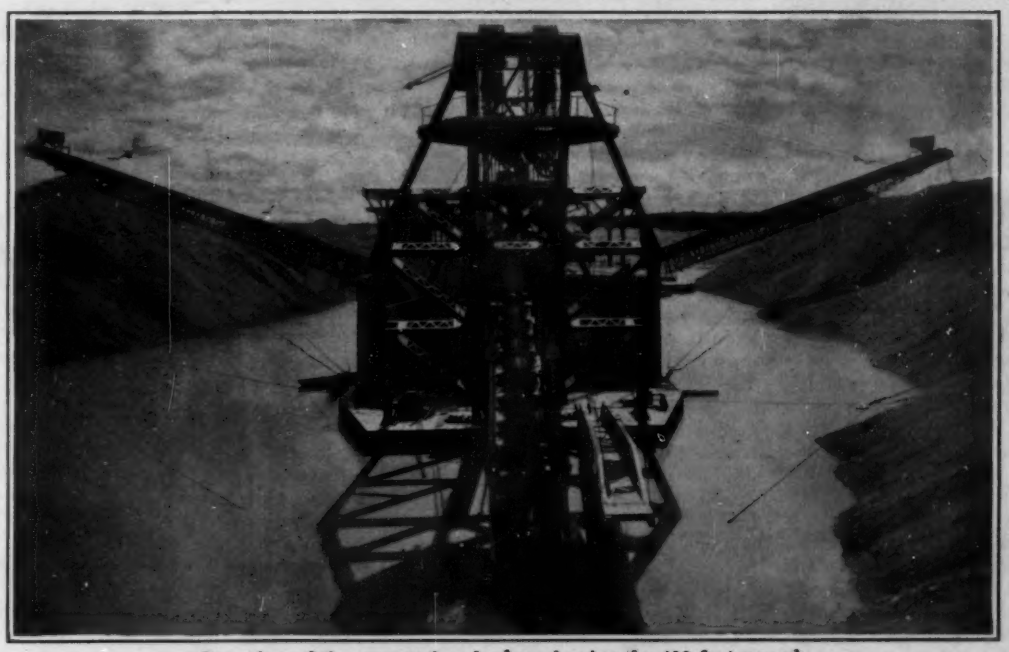
A Two-Stacker Gold Dredge

THE owners of the world's most extensive gold dredging field desired to dredge the present stream bed of the Yuba River, California. It was impossible to work the dredges directly out into the river, as the spring freshets would have almost certainly damaged the expensive dredges. In addition, the California Debris Commission would nothave permitted this actual mining work in the running water where the fine silt, loosened by the operation of the dredge, would have been swept down stream to fill up the channel.

Therefore, if the gold in the stream bed was to be recovered it was necessary to divert the river. This was possible, but the engineers of the dredging company desired to do it at a minimum of expense. The plan that was finally evolved is an interesting one.

Two 18-cubic-foot dredges, styled Yuba No. 14 and Yuba No. 15, were erected. These dredges were of the single-stacker type, and each cost about $500,000. Starting near the upper end of the property, they worked out from one bank, and then turned down stream. The tailings from the operations of the dredges formed a well packed retaining wall measuring about 400 feet thick, and about 40 feet in height above any known high-water mark.

Then came Yuba dredge No. 16 with the two stackers, an innovation in dredge design. This dredge worked directly into the partially opened channel, clearing it up, adding to the retaining walls, and at the same time



Bow view of the two-stacker dredge, showing the 400-foot spread

View across the dredge, from the end of one stacker

recovering the gold value of the gravel.

At no time in the operation of any of these three dredges has any amount of barren ground been moved. Every yard of earth moved has been handled at a profit. This work has been carried out with the consent of the War Department, acting in conjunction with the California Debris Commission.

Yuba No. 16, starting work in April of this year, is the largest gold dredge ever constructed. One photograph shows the dredge as she first began to clear out the upper channel. This dredge is capable of digging to a depth of 82 feet below water. It is entirely of steel throughout and weighs 2,500 tons. The hull is 165 feet wide and 11½ feet deep. The maximum height above water of the stacker gantry is 103 feet. As in all gold dredges, only the highest grade steels are used, the bucket line being entirely of manganese steel with oil tempered nickel chrome steel buckets. There are 100 buckets in the line, each of them weighing 2¼ tons. The upper tumbler and shaft weigh 21 tons.

This dredge will handle about 350,000 cubic yards of gold-bearing gravel per month. The cost of operation will not exceed three cents per cubic yard, the cheapest method of recovering gold known to man. This is equivalent to an extraction cost of two cents per ton.

A mine on Douglas Island, Alaska, probably holds the world's record for sustained low cost of the mining and milling of ore. This cost amounts to just a bit less than one dollar per ton. The difference is due, of

(Concluded on page 34)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Tractor Behind the Lines

IT is upon the tractor that much of the burden of the increase in crop production will fall this year and next. Horse flesh cannot stand the strain of long hours of terrific work, and, on the larger farms especially, are being replaced with tractors which can be worked twenty-four hours a day if necessary. During the rush of planting the spring crops this year, thousands of farmers were compelled to work sixteen and eighteen hours a day in the fields in order that they might do their bit. One can readily imagine the wear and tear upon horse flesh. For this reason, as well as many others, the tractor promises to become the mightiest instrument of peace used in winning the war, for its value in a crisis such as the present one is many times that of the war machine into which it has been converted abroad.

The availability of the tractor for all-round farm work —it can be used for everything that has required horse-power in the past—is being demonstrated most aptly in the fields of the middle western states this year. For plowing, disking, cutting hay, planting corn, harvesting wheat and oats, hauling loads of farm produce to the market, operating silos, and doing the thousand and one things for which power of some kind is required, the tractor is unbeatable. It has been worked night and day in many districts and has been responsible for such states as Kansas, Nebraska and other wheat belt states making a good showing this year despite the fact that millions of acres of winter wheat were killed by the severe cold weather.

In Kansas the situation would have been most serious if it were not for the fact that the state council of defense mobilized the tractors and put them to work on a schedule of from eighteen to twenty-four hours a day. More than 4,000,000 acres of wheat had been winter-killed in Kansas, presenting an unusual problem for the Kansas farmers who desired to do their bit in the campaign for increased food production. A fleet of 4,000 tractors was kept busy for several weeks plowing this ground and preparing it for corn and other spring crops, and the sight of tractors working during the night-time, with the aid of lights borrowed from automobiles, grew to be a common one, until the council of defense announced that the crisis has been passed successfully. Night shifts had to be provided for the tractors and these weapons of peace had to be so distributed that no community in the state would suffer because of lack of power with which to plant the spring crops. The workers on the night shift usually were taken to and from their work in automobiles provided by the business men of the towns, who did this as a patriotic service.

Thousands of farms which have been worked with horse-power heretofore, this year will add tractors to their equipment, or else will draft the family automobile for that work. It was not an uncommon sight to see the family car pulling plows, planters and other implements through the fields during the early days of the crop-planting season. In almost all of the states courses for tractor operators were established in the state institutions of learning. The state of Iowa gave a week's short course to a class of more than twenty young women who wished to return to their homes and help their fathers and brothers till the fields by running the family tractors, either as extra or regular workers.

Providing good weather permits the use of the average dirt road for hauling purposes this fall, huge quantities of farm crops will be moved to market with the aid of tractors. The sight of long trains of wagons loaded with grain and propelled by a tractor will not be an uncommon one, especially where the larger farms are located. These tractor-trains will permit the moving of crops night and day if it should become necessary, and will do much to solve the farm transportation problem. In farming districts where hard surfaced roads are found tractors will be used in hauling crops to the larger market centers, which will relieve the railroads of much short-haul business.

An important factor in arousing the farmer to the addition of tractor power to his equipment is the high cost of feeding work horses. A tractor can be supported for much less than the cost of feeding four or five horses required to do the same work, and can be worked twenty-four hours a day. Banks in the farming states have loaned large sums of money to aid farmers in purchasing tractors as an important means of financing the crop production work.

Fire Prevention as a War Measure

EVERY day furnishes increased evidence that the world is racing with starvation. Every means which ingenuity can suggest to increase and to conserve our food supply must be seized upon. And since conservation affords a better chance of immediate results than increased production, our attention has rightfully been very largely centered upon the elimination of waste. We are urging everybody to throw away nothing, to buy nothing which cannot be consumed, to restrict consumption to the lowest level compatible with efficiency, above all to permit nothing to be wasted as an incident to production. But one item of preventable waste which has failed to receive its due measure of publicity is the fire waste.

Fire loss is to a very large extent wholly preventable. Under any circumstances the huge American fire figure stands as a national indictment. At the present time it would be a deliberate crime against humanity to permit this loss to continue at its normal, disgraceful rate. The most intensive program of fire prevention for all elevators, flour mills, potato and onion warehouses, and food repositories generally, is a matter of the utmost necessity. The successful fruits of such a campaign should preserve a living for unnumbered thousands whose food requirements would be destroyed were the fire loss to remain at its usual level.

Little, if any, less important is the conservation of the cotton crop—that great staple whose employment in the manufacture of explosives, as well as of fabrics, makes it an indispensable war-time necessity. The United States is the source of the best part of the world's supply, and it is imperative that this supply be not diminished through fire. Then, too, with the growing certainty that every ounce of the nation's strength will be required, it would be intolerable to continue the drain of preventable fires in coal properties, fertilizer works, saw mills, piers and wharves, and the many other essential industries which have not made quite so bad a showing as have those specifically mentioned.

It is of the utmost consequence that every individual in the United States consider himself a committee of one to coöperate in the removal of all unnecessary fire hazards that may come within his knowledge. The urgency of this cannot by any possibility be exaggerated. The difference between adequate attention to this warning by every resident of our country, and its complete neglect by all concerned, might very well be the difference between winning the war and losing it. And while of course this figure is an overdrawn one in the sense that certainly everybody will not ignore the warning any more than everybody will heed it, this fact does not in any degree diminish the measure of individual responsibility. Every one of us can contribute something to the lessening of the fire loss for the year to come.

What of German Science?

IN the early days of the war—before it was our war—we commented more than once in these columns upon the fashion which prevailed in Great Britain and France, of speaking disparagingly of German science. To the neutral bystander there was matter for mirth, tears and bewilderment in the suddenness with which long-cherished idols of Teutondom were found out to have feet of clay. What we referred to at the time as "the scholars' war" was waged in some quarters in a spirit of ignoble chauvinism hardly equaled in the war of armies and governments. The intellectual achievements of the Germans were belittled with an excess of zeal that completely missed its mark, and produced only the proverbial effect of the boomerang.

Happily these manifestations have since abated. Happily, too, they have not been repeated on this side of the Atlantic since our own entry into the war. They were unworthy of scientific minds because—if for no other reason—they were grossly illogical. A good thing is no less good because it is used for unworthy ends. The genius and industry of German men of science are not, in themselves, one whit less worthy of admiration and emulation today than they were three years ago. Indeed the results which German science has achieved when used as an agency of destruction furnish conclusive proof that its powers have not, in the past, been overrated by the world at large; though, of course, there have always been some extremists who could see no good in anything that was not "made in Germany."

Scientific knowledge is too precious a thing to be suppressed or rejected because we disapprove of the source from which it comes. Let us indulge our patriotic sentiments, if we please, by removing sauerkraut and pretzels from our bills-of-fare, or by finding indigenous substitutes for the German names of streets and villages. Nothing vital to our national welfare is sacrificed by such proceedings. But it would be an error of judgment to banish a single sound German text-book or reference book from our shelves.

Boycotts, of one sort or another, of the intellectual products of Germany have been seriously proposed. It has been suggested, for example, that our scientific journals might refrain from publishing translations and abstracts from German during the war. Undoubtedly the publication of such literature is a compliment to the intellect of our enemy. But since a fine intellect is, unfortunately, not incompatible with perverted ethics, recognition of the former implies no sort of approval of the latter. Moreover, it is not the part of prudence to underestimate the mental ability of one's antagonist.

When we attempt to define our personal relations to the Germans who were lately our honored co-workers in the cause of science we tread upon delicate ground. We feel that they are misguided and that the sentiment of patriotism—which has little to do with logic, either at home or abroad—has overpowered their judgments on certain subjects. No doubt this opinion is quite reciprocal.

Probably the prevailing attitude of American men of science toward their late colleagues in Germany is not one of bitterness, but of infinite sadness that circumstances have made so wide a breach between them. We use the word "circumstances" advisedly. Are we not all the victims of circumstances over which we have no control, or next to none?

Certainly if nations were governed by scientists instead of politicians there would be no wars. Hence, it is a hopeful sign of the times that the war—which has done so many other unlooked-for things—has given science far more political prestige than it ever enjoyed before.

The Progress of Cremation

SOME recent publications on the subject of cremation—especially an article by Dr. Hugo Erichsen, ex-president of the Cremation Association of America, published by the Michigan State Board of Health—make it timely to present a brief pendent to the editorial remarks on this topic that appeared in our issue of February 26th, 1916.

Probably few people not professionally interested in the matter realize the rapid progress which this enlightened method of disposing of the dead has made in the United States. On the North American continent there are now 62 crematories, and nearly 15,000 incinerations take place every year. Indeed, apart from Japan, America has taken more kindly to this practice than any other country where it is not indigenous and general.

The arguments for and against cremation have often been set forth, but it may be interesting to quote here, from Dr. Erichsen, an illustration of its economic advantages: "In the city of Detroit," he says, "there are 420 acres within the confines of Elmwood, Mt. Elliott and Woodmere cemeteries, which have become part of the municipality and are now all within the city limits. All of this land, it should be remembered, is exempt from taxation. Instead of this enormous waste of valuable land that could be used to better advantage for the production of food or for dwelling purposes, a columbarium (urn-hall) covering *one* acre would hold the remains of all the dead interred in these graveyards if they had been cremated."

Religious prejudice is still the greatest obstacle to the general adoption of cremation, but this prejudice is by no means so strong as formerly. The Protestant Episcopal Church permits its clergy to officiate at cremations, and some of the leaders of that church, as well as of the Church of England, have been warm advocates of the custom. Thus Bishop Lawrence of Massachusetts, is a vice-president of the Massachusetts Cremation Society; the late Bishop of Truro was cremated; and the Bishops of Oxford and Lincoln are active supporters of cremation. It was a late Bishop of Manchester who asked, when the practice was under discussion at a church convention: "If the destruction of the human body by fire prevents the resurrection, what in that case became of the holy martyrs?" The Lutheran Church meets the question half way by permitting its ministers to officiate at the house.

The same writer gives a list of prominent "crematists," including General Goethals, Maud Ballington Booth, Mary Johnston, Norman Hapgood, Bishop Samuel Fallows, Admiral Peary, General Greely, President Jordan of Leland Stanford University, and others. Among prominent persons recently cremated may be mentioned: Jack London, Richard Harding Davis, Prof. Hugo Münsterberg and Senator J. M. Thurston.

The process of incineration has greatly improved in recent years, and there has also been marked progress in the beautification of crematories, as to architecture and surroundings.

Astronomy

The American Astronomical Society will hold its twenty-first meeting from August 29th to September 1st, in Albany. In accordance with the society's regular plan of meeting at various observatories throughout the country, the forthcoming assembly will be held at the Dudley Observatory. A visit will also be paid to the observatory of Vassar College, Poughkeepsie.

A Variable Asteroid.—A Harvard College Observatory bulletin states that from an examination of photographs taken with the 10-inch Metcalf anastigmat, Miss S. Raymond has found the asteroid (129) Antigone to be variable, with a range of about 0.4 magnitude and a period of two or three hours. This variation has been confirmed photometrically. The observation recalls the remarkable variation that has been observed in the brightness of the asteroid Eros, having a period of the same order.

The End of the Litchfield Observatory.—After having stood idle for many years, the Litchfield Observatory of Hamilton College, Clinton, N. Y., has been torn down. This observatory was founded in 1858, and with the exception of Harvard and Ann Arbor was then the best equipped observatory in the country. Its first and only director was Dr. C. H. F. Peters, who remained in charge until his death in 1891. During this time Peters was engaged in the observation and charting of star zones, and he also achieved a world-wide reputation as a discoverer of 47 asteroids.

The Observation of Asteroids in America is now hampered by the fact that the war has suspended relations with the Berlin Recheninstitut, which is the international clearing-house of information concerning these little planets, and which ordinarily distributes each an ephemeris of their oppositions for the coming year, with elements of their orbits, etc. The asteroid committee of the American Astronomical Society has been obliged to suspend some of its undertakings on account of this situation. Meanwhile, the committee urges that efforts be made to explain the variability of certain asteroids, and in this connection is considering the advisability of experimental studies on the reflection and diffusion of light by rocky surfaces, possibly by means of aeroplanes.

An Eclipse at the South Pole.—At the last meeting of the American Astronomical Society, Prof. William F. Rigge called attention to some remarkable features of the annular eclipse of the sun which will occur Dec. 13th, 1917. The central line of the eclipse passes through the south pole of the earth; hence the eclipse will be visible in all longitudes and at all hours of local time. The most curious fact which Prof. Rigge brought out in connection with the eclipse is this: If we think of the south pole as lying at sea-level, then the central line passes about four miles from the pole, and the axis of the shadow cuts the prolongation of the earth's axis 9,107 feet above the pole. But from the reports of Amundsen and Scott we know that there is a lofty plateau at the pole, with an elevation of about 10,000 feet. In view of this elevation of the ground, it may said that the central line of the eclipse passes exactly through the south pole.

A New Catalogue of Stellar Parallaxes, compiled by Rev. O. R. Walkey, has been published by the British Astronomical Association. The stars are grouped according to spectral types, and number 625, as compared with 365 in the list published by Kapetyn and Weersma at Groningen in 1910. The list does not include the Hyades group, but does include six nebulae and six novae. The absolute luminosities of all stars are given, in terms of that of the sun. In view of the fact that this list presents all available trustworthy data of stellar parallax, the compiler remarks that "our knowledge of stellar distances gained by direct measurement is still very fragmentary and it does not appear how it can be improved in the nost needed aspects, namely the distances of the remote stars, seeing that these lie hopelessly beyond our present (even photographic) refinements."

The Census of the Sky.—The recent publication of the Cordoba Visual Durchmusterung is another important step in the perennial undertaking of cataloging all the stars in the sky down to the 9th or 10th magnitude. The new volume covers the region from 52 deg. to 62 deg. S. declination, and the four volumes extend from 22 deg. to 62 deg., embracing one-half the area south of the equator. Since Argelander's classic Durchmusterung covers the northern hemisphere, and Schönfeld's continuation of it extends to 23 deg. S., all but about one-seventeenth of the sky has now been observed visually. This gap, in the southern heavens, has been covered by the Photographic Durchmusterung, completed under Gill at the Cape of Good Hope, and reduced by Kapetyn. The visual census of the southern sky was originally planned by Dr. B. A. Gould, the first director of the Argentine National Observatory. The first two volumes of the Cordoba work represented seven years' work by two observers, one of whom, Dr. Thome, spent about fifteen years on the other two volumes. The total number of stars cataloged at Cordoba is about 580,000.

Science

The Wild Relatives of Our Crop Plants, and their value in plant breeding, formed the subject of a paper recently presented by Mr. W. T. Swingle before the Botanical Society of Washington. These plants are highly useful in securing such desirable qualities as hardiness, earliness or lateness of blooming or ripening, disease resistance, extra vigor, etc. Thus the desert kumquat, of Australia, though it differs much in appearance from true *Citrus*, has been found valuable in breeding hardy and drought-resistant citrous fruits. Every plant breeder should have a thorough knowledge of the wild relatives of the plants with which he works.

Industrial Fellowships of the Mellon Institute.—Dr. R. F. Bacon, director of the Mellon Institute of Industrial Research, has published a report on the recent progress of this unique institution. The confidence which industrialists have in its undertakings is shown by the steady growth in the number of fellowships and the amount of money contributed for their maintenance. For the current year the fellowships in operation number 42, the fellows holding them number 64, and the money grants amount to $147,000. The total number of fellowships up to date is 115. About seventy per cent of the problems assigned to fellows during the five years ending March, 1916, were solved to the satisfaction of the donors. Dr. Bacon states that the establishment of industrial fellowships in accordance with the system in operation at the Mellon Institute is being considered by Massachusetts Agricultural College, Harvard University, Washington State College, McGill University, University of Sheffield (England), Sir John Cass Technical Institute (London), Sydney University (New South Wales), and the University of Tokyo.

Prehistoric Use of Meteoritic Iron.—In the Old World the art of smelting ores was discovered about 1200 B. C. It has sometimes been suggested that iron tools and weapons may have been made at an earlier period from meteorites, and recently a considerable amount of evidence in behalf of this hypothesis has been presented by Mr. C. F. Zimmer. He has compiled a list of the known iron-containing meteorites, nearly all accumulated within the past century, and he shows from these alone about two hundred and fifty tons of iron might be obtained. Of this amount more than ninety-nine per cent is malleable, consisting of a nickel-iron alloy. He also shows by means of a series of illustrations how easy it is to detach from the meteorites fragments of iron suitable for use as tools or implements when mounted in handles. Thus it seems fairly probable that a widespread use may have been made of meteoritic iron in prehistoric times. At the time of the Spanish conquest of Mexico the Aztecs had iron knives and daggers, which they declared had been obtained from the sky. Moreover, the use of meteoritic iron by Eskimos and American Indians is a matter of recent history.

American Indian Designs for Textiles.—Dr. H. J. Spinden, of the American Museum of Natural History, New York, is making a three months' journey in Central America for the purpose of obtaining textile designs suitable for use by American manufacturers. This is in pursuance of a movement that has been under way for some time to lessen the dependence of our textile manufacturers upon European traditions. The collections of the American Museum of Natural History and also of the National Museum in Washington have already supplied many attractive motifs. The former institution recently held an exhibit of figured textiles to show the success which has attended this movement. Dr. Spinden is also studying details of the art of weaving and the dye-stuffs used by the native artisans. It is said that the costumes worn by the Indians of Central America, besides being picturesque, present many details of construction which might be successfully adapted to a wider use. Further studies will be made concerning the native food products, and specimens of these products will be collected for display in the Preparedness Exhibit which the American Museum has now under way.

Soap Bubbles a Year Old.—The transient existence of the soap bubble is proverbial, but Prof. J. Dewar, in a discourse recently delivered at the Royal Institution in London, explained how soap bubbles could be made to last for months, and exhibited several specimens. The first requisite is that the air used in blowing the bubble shall be free from dust. In Prof. Dewar's process the air is filtered through cotton wool, and the bubbles are blown by opening a stop-cock in the air-supply tube. For the soap solution he prefers the purest oleic acid (tested by the iodine number) and ammonium soap (not potassium or sodium). To make a bubble durable the sac of liquid must be removed from its bottom by suction through tubes applied from outside. The lecturer showed bubbles more than half a yard in diameter, blown in glass vessels containing pure air at atmospheric pressure. A little water is kept at the bottom of the vessel. A uniform temperature of about 50 degrees Fahr. is favorable to longevity. Some of Prof. Dewar's smaller bubbles were nearly a year old.

Aeronautical

Is the Airman's Calling Dangerous?—According to the statistics of war losses received from the Allied governments it appears that there are other duties more dangerous in the present war than that of aviator. It is said that the records of Allied losses place the air service fourth in the percentage of losses. The medical corps has sustained the heaviest losses, followed by the infantry, with the artillery arm in third place.

"Shooting" at an Enemy with a Camera.—A novel method is to be used at the Mineola flying school in the training of civilian aviators. It is planned to use cameras in target practice, so that with a camera mounted on his machine instead of a machine gun, but operated by regular gun sights and trigger pull, the student aviator will be able to "shoot down" a certain machine designated as the enemy. The developed negative will indicate his success or failure in inflicting the desired results on the "enemy."

Training Observers by means of Dummy Trenches.—In describing the training of observers, a press correspondent describes the first lessons that are given in observation work as follows: On a model landscape laid out on patch of open country were railway stations, tramway lines, level crossings, churches prominent thoroughfares, and landmarks, indicated by variously painted squares of turf. Enemy positions were distinguished by little green-colored curves. The airmen were temporarily arrested by a supposed bombardment from the German trenches. Finally they spotted the target, presumably the headquarters of a German Brigade Staff, then signalled the range to the British batteries, and a moment later gave the word to "open fire." It is by means of this model landscape that the British observers are coached.

A Mirage Collision in the Air.—The following remarkable story of a mirage in the clouds is told by a young Flying Corps officer in the following letter to his father, which appeared in a recent issue of *Flight:* "I had often wondered what it would feel like to see a machine coming straight for one and to know that a collision was inevitable. I had the experience this afternoon, only the collision did not take place. I was on patrol with five other machines over the lines—by the way, I am writing this like a novel, but I feel like it—and had just gone into a cloud bank. Just before going in I saw the 'bus on my right turning to cross in front of me. All of a sudden I saw a machine just the same as my own appear out of the cloud about 50 feet away, making straight for me. Instinctively I jammed my nose hard down and went as near a nose-dive as possible; the other 'bus did the same. I turned; the other turned into me. I was in a cold perspiration all over by this time, so I thought 'Here goes; if I am going to crash it might as well be complete.' So straight for it I went. We got closer and closer, and biff! my machine and—its mirage in the clouds met. It seemed like a hideous nightmare, and I can still see that machine doing its utmost to crash into me. I think I can say I have had the full horrors of a collision in the air without its actually taking place. I finally got out of the clouds, and had not the faintest idea where I was, but about fifteen seconds after 'archie' reminded me that I was a little too low over his lines. Having got that off my chest, I think I will go to bed."

The Field of the Dirigible Balloon.—M. Mallet, a pioneer constructor of spherical and dirigible balloons, recently granted an interview to E. Percy Noel, the correspondent of the New York *Globe* and the Chicago *Daily News*, during which he brought out several interesting points bearing on the value of dirigibles in modern warfare. The greatest utility of dirigibles, according to M. Mallet, is over water. While he concedes that the present-day anti-aircraft artillery has rendered dirigibles impracticable for overland bombing expeditions, he emphasizes the fact that "as a naval scout to work twelve or twenty-four hours daily the dirigible is unexcelled." The most effective weapon we could employ in guarding our shores against enemy submarines would be small dirigibles, of the two-engine type, with a speed of from 30 to 40 miles an hour and carrying fuel for 200 or 300 miles. M. Mallet undoubtedly has the "blimp" type in mind. Anti-submarine armament could, of course, be substituted for fuel aboard dirigibles making short runs. With a suitable mosquito fleet and harbors for them every 200 miles or so along our coasts, it would be possible to patrol day and night. The fact that dirigibles are slower than hydro-aeroplanes is no disadvantage, since speed is required only to combat heavy winds. At other times the slower they are the better, for at an altitude of several hundred feet it is possible while moving slowly to see underwater craft at a depth of from 60 to 70 feet. M. Mallet concludes with the remarks that "details of communication by wireless to anti-submarine watercraft, or to hydro-aeroplanes for the capture or destruction of submarines are not in my province, but your navy knows what to do when given the location of a submarine if, indeed, the dirigible itself is not also used for the purpose of attack."

A Sea Fight In the Adriatic

Destroying a Mine-field Under the Guns of the Enemy

By Captain F. E. Kleinschmidt

CAPT. M——, commander of the marine forces of Triest, told me last night I should hold myself ready at a moment's notice for an interesting adventure. Presuming it would be another aeroplane flight over the enemies' territory, I kept my servants and chauffeur up late, and then finally laid down, fully dressed, with cameras and instruments carefully overhauled and packed. At 7 o'clock next morning the boatswain of the launch "Lena" called at the hotel and told me to follow him. "The Captain," he said, "could not accompany me! but he had instructions to take me out to sea, and then obey my orders." An auto took us to the pier, where a fast little launch lay ready. This time she had a machine gun, with ready belt attached, mounted in her stern, and flew the Austrian man-of-war flag. Not until we were well out to sea did the boatswain tell me we were to sneak over to the Italian shore, and demolish a hostile mine field. The prevailing fog and exceptionally calm weather made it an ideal day to accomplish our purpose. The fog prevented the Italians from seeing us, and the calm sea made it possible to lift and handle the mines with a minimum of danger to ourselves. Two tugboats and a barge had already preceded us early in the morning. After an hour's run the three vessels suddenly appeared before us, and we drew alongside the tugboat No. 10, already busy hoisting a mine. I jumped aboard and reported to Capt. K——, in charge of the expedition. To my chagrin he refused to let me stay. The first reason was, it was too dangerous work, and he would not take the responsibility of my being blown up; and second, we might be surprised by the Italians at any moment and be sent to the bottom of the sea. All my arguing and insisting upon the orders from his superior proved useless. He insisted upon my return, or written orders clearing him of all responsibility. So I had to go back in the launch to Triest and report to Capt. M——, about the scruples of the commander of the mine expedition. I also offered to leave my servants (two Austrian soldiers) ashore, and sign a written waiver of all responsibility should anything happen to me.

The ever generous and obliging Capt. M—— said he would accompany me himself, so out we raced for the second time, and I had the satisfaction to stay and photograph, not, however, before the cautious Capt. K—— made another attempt to scare me out of it. First he explained in the style of a general staff officer the business at hand: We were about three miles off the Italian coast near X——. The most dangerous work, namely, the lifting of the first mine had been accomplished during my return to Triest. The nature of the beast had been ascertained. The construction was a new one, of the defensive type. With good care and a smooth sea the mines could be hoisted, made harmless, and be saved. There would be, he hoped, no explosions, and working quietly we would not draw an Italian fleet down upon us.

Attaching the cable to the mine with the aid of a water telescope

Tug No. 10 and the barge—the latter blown up 15 minutes after this photo was taken

Pushing down the lever that renders the mine safe to handle

There are mines of offensive and defensive purposes—such as you lay in front of your own harbors to protect you, and such as you lay in front of the doors of your enemy. The first ones you might want to move again; therefore, they are so constructed that you can handle them again, provided you know the secret of construction. The other kind you don't expect to touch again, and they are therefore so constructed that anyone who tampers with them will blow himself up. Secondly, should the Italians surprise us, there would be little chance for us to escape. We could steam only about ten knots, while any cruiser or torpedo boat could steam over twenty. The only armament we had was one 75-millimetre Hotchkiss gun in the bow. There would be no surrender either. He would blow the barge and his own steamer up first.

"Here," he said, pointing to a tin can the size of a tomato can, with ready short fuse attached, "is the bomb to be thrown in the barge, and here," looking down into the forward hold, "is the other one ready to blow us into eternity. Now if you want to stay, you're welcome; if not, take the launch back to Triest."

Captain M——, after a brief inspection, went back with the launch to Triest, while I stayed and photographed with moving picture camera and Graflex.

There is a long international law governing the laying and exploding of mines, and there has been considerable controversy about the unlawful laying of anchored and drifting mines. There are land, river and sea mines. Mines laid for the protection of harbors are usually exploded by electric batteries from an observing officer on shore. Others are exploded by contact. The mechanical devices to accomplish this are manifold. The policy adhered to is usually to construct a mine so as to incur the least danger, when handling them, to yourself, and with the opposite results to your enemy. This holds true as long as the secret of construction can be kept from the enemy. The Italians on a night invasion had dropped mines on the Austrian coast that would explode when tiled only at an angle of 25 degrees. A little vial of acid would spill over and explode the charge. One day, when a heavy sea was running, some of the mines exploded, betraying the location of the mine field, and the Austrians "killed" the rest of them with mine sweepers.

Mine fields are discovered by shallow-draft steamers looking for them in clear

The mine no longer "alive" is now hoisted aboard the barge

Bringing aboard the anchor which sinks and pulls the mine down into position

water or dragging for them. The aeroplane is also an excellent scout. From a height of 1,000 feet he can look a good depth into the sea, and see a mine or submarine. On my flight over Grado, on the Italian coast, I could see a mine field and all shallows of a channel wonderfully well from a height of 6,000 feet. When the hydroplane sees a mine, an automatic float is dropped that marks the locality, and the mine boat comes along and either lifts it or blows it up.

These Italian mines were of a late and very expensive construction. They consisted of three parts—the mine, the anchor and a 100-pound weight; all three connected with a wire cable. The weight is an ordinary oval lump of iron, attached by a cable to the anchor. The anchor is a steel cylinder; the upper part is perforated; the lower half is a tank with a hole in the bottom and sides to allow the water to enter and sink it. The mine is a globe 2½ feet in diameter, which fits into the barrel-like anchor up to its equator.

The weight, cable and anchor holding the mine are rolled from the mine-laying ship, overboard. The weight sinks to the bottom holding the mine in the spot. Next, the water entering the tank slowly fills it, and it sinks at the designated place. The mine, being buoyant, has detached itself from the sinking anchor, and is pulled down with the anchor and floats now at a depth of eight to twelve feet from the surface. The water now dissolves a peculiar kind of cement that has held a number of pistons. The pistons being released, spring out and snap in place all around the equator of the mine. Comes a vessel in contact with the mine, these protruding points, made of brittle metal, break off and a spring releases a cartridge with explosive. This cartridge, with a detonation cap on the bottom, drops upon a point and explodes the initial charge, which again explodes the charge in the mine.

In lifting the mine a rowboat with three men rows up over the mine, and by means of a tube shutting off the refraction of the light rays a person can look into the water. With a boat hook and attached rope, a shackle on top of the mine is caught, the pole is unscrewed, the rope is taken to a winch aboard the steamer or barge, and the mine is then carefully hoisted. When the mine comes to the surface the mine engineer rows up, presses down a lever, and secures it with a steel pin. This performance locks the springs, and prevents the cartridge from dropping on the piston. Next, the mine is hoisted on the barge, the top is unscrewed and the cartridge holding the initial explosive charge is taken out, rendering the mine harmless with ordinary handling. The cylinder-like anchor is then hoisted by the attached cable, and last the weight is brought up.

We were busy hoisting and searching for mines till 3 P. M. Another tug boat, the "San Marco," was also steaming around in our vicinity, keeping a sharp lookout for hostile men-of-war, and also when seeing a mine, dropping a float. The fog had lifted a little, and once in a while we could see the outlines of houses on the shore. We had six mines on the barge and three on our steamer, when the launch which had taken me out hove in sight to take me back for dinner. Capt. K—— said: "Well, we have been lucky so far, we have only one more mine, to take up, and I had a good mind to blow it up and hike for home."

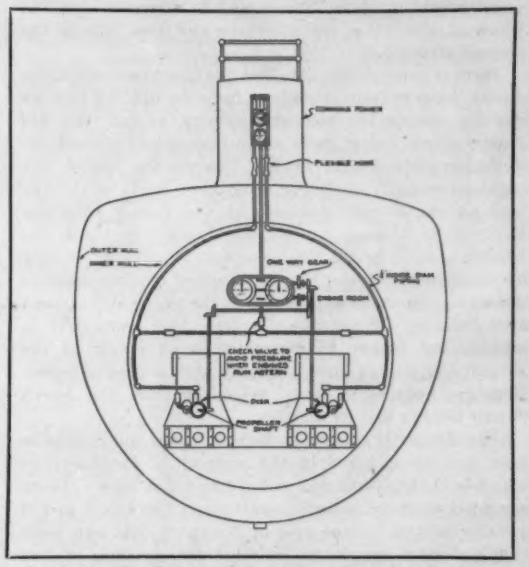
"Good," I said, "then I'll unpack my cameras again and take a picture of the explosion." At this moment the "San Marco" gave a signal of three short blasts. I looked toward the Italian coast and saw two men-of-war loom up in the fog; then two more. Two had four funnels each and were cruisers; the other two were torpedo boat destroyers. "The Italians are coming," someone shouted.

"Where, where," shouted my servant. "Here, right close," cried a sailor, mistaking in the fog the "San Marco" for the Italians.

"Now, we are lost; there is no use; they have got us," cried my servant.

"Enemy in sight." "Clear the ship." "Jump aboard." "Cut the barge adrift", came in sharp commands from Capt. K——.

Six men at the windlass were just lowering a mine carefully onto the deck of the barge. They let it drop so suddenly that the men guiding it jumped aside in terror. All hands jumped from the barge aboard our steamer. The ropes holding the barge alongside were cut, the bells clanged in the engine room, and we shot ahead. A swad of fog had momentarily blotted the



Cross-sectional view of the submarine, showing how the dead-reckoning device is piped up

vessels out again and gave a false sense of security. "Make the towing hawser fast; we'll tow her," shouted K——. Three men tried to belay the hawser, but we had too much headway on already, and the rope tore through their fingers.

"Throw the bomb into her."

The bomb flew across, but fell short; then I saw a flash of lightning in the fog, and the next moment a huge fountain of water rose on our starboard side, and the first shell flew screaming past us. Boom! boom! boom! Now all four ships gave us their broadsides, and the striken sea spouted geysers all around us and the "San Marco." Screaming shells and roaring guns filled the fog.

"Twelve hundred meters," quoth K——, "they should soon get the range." I looked at our little Hotchkiss on the fore deck—there was no use to reply even. The "San Marco" had described a half circle and came running up astern of us as if like a good comrade she was going to share our fate with us. As she came abreast of our barge K—— shouted: "Drop a bomb into her."

"I have only one ready for my own ship," the Captain yelled back.

"The Devil! They will get our whole day's work," cursed K——.

"Hurray!" we all shouted the next minute, as a shell struck the barge full center, exploding the six mines and shattering it in bits, enveloping all in a dense cloud of black smoke.

At this moment the other launch came alongside and raced along with us. I threw my cameras into it, and jumped aboard; then we sheared off again, so as not to give the enemy too big a target.

Next minute three shells shrieked so close to our ears that we threw ourselves flat in the bottom of the launch and one shaved the deck of the No. 10. There seemed to be no escape. The Italians cut us off from Trieat, and

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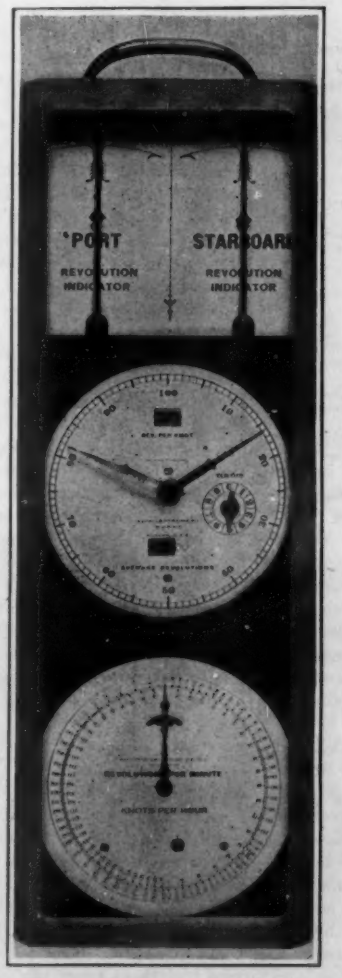
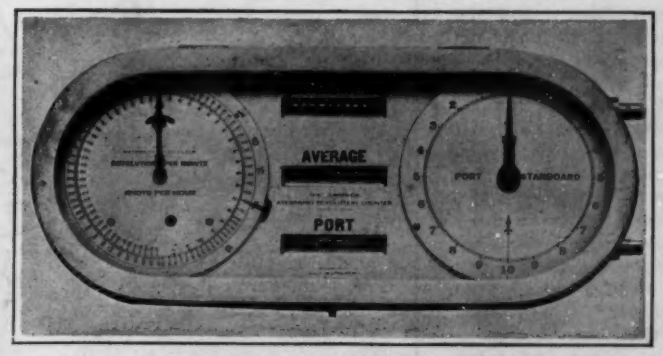
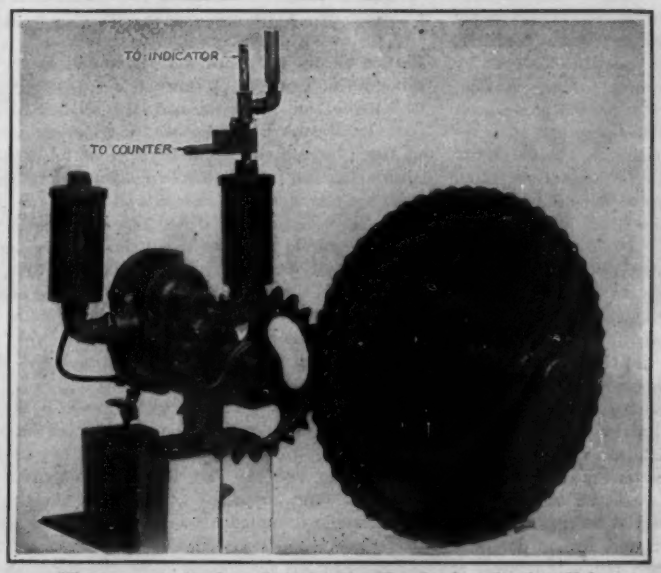


The conning-tower gage panel



The engine-room dials



The gear mechanism that operates the dead-reckoning dials

How Submarines Feel Their Way When Submerged

"WHEN passing through the North Sea, we ran submerged for six hours," read the "Deutschland's" log. But how her captain knew how far he had gone under the surface and when it was safe to come up has always been a puzzle to the lay mind. If the "Deutschland" is equipped with one of the automatic dead-reckoning devices now being fitted on American submersibles, her captain simply read a gage which told him how many miles he had gone on that particular course without any computations on his part whatever.

No other vessel is so dependent upon the revolution of her propellers to determine her location as is the submarine. When submerged there are no buoys or land marks, taffrail logs or lightships, and even the instinctive method of sniffing the air is of no avail. The navigator must rely solely upon the propellers to determine his position.

The device shown in the accompanying illustrations makes use of the revolutions of the propellers to produce an automatic dead-reckoning means which is as simple as reading time on a watch. It consists of two small rotary air pumps driven off the propeller shafts. These produce vacuum or pressure in pipe lines leading to gages equipped with bellows which contract or expand to move the reading hands. The gages are placed on two panels, one in the engine room and one in the navigating station in the submarine's conning tower. These gages are so adjusted that a certain number of revolutions of the propellers sufficient to move the vessel ahead a certain distance will show that distance direct on the dial gage by the movement of its hands. The device does this automatically and eliminates the necessity of the engineer reading the revolution counters, watching the clock and then calculating with pencil and paper the number of miles that the vessel should cover with the engines running at that speed. The device has the added advantage that it gives this information directly to the navigation officer, by simply reading the gages in front of him, thereby doing away with the necessity of calling down a speaking tube to the engine room to get the information.

The engine-room panel carries one revolution counter for each propeller shaft and one for the average of the two shafts, the former operated through one-way gears. The panel also contains a one-hand tell-tale and an automatic stop clock. The are operated by means of bevel gears and shafting driven from the propeller shafts as shown in the sketch. The counter for each shaft shows the revolutions of that shaft, while the average counter gives the algebraic average of the two. The stop clock indicates the average revolutions per minute for both engines. This information is used to indicate the speed of the vessel in knots per

(Concluded on page 36)

Strategic Moves of the War, July 5th, 1917

By Our Military Expert

THE principal theater of war, at least the one of the greatest interest at present, has been transferred from the Western to the Eastern front in Galicia, where the Russians have begun their first forward movement since General Brussiloff's armies stopped last year, presumably for want of munitions. After hours of fire by artillery, assaults upon a front of forty miles or more were delivered on July 1st and succeeding days over a field of battle extending from the upper banks of the Strypa River west and northwest of Tarnopol to the western banks of the Zlota Lipa River below Brzezany.

The objects of the Russian commanders are plain as their concentric pressure on the center of the Teutonic lines on the Eastern front develops. Infantry and artillery battles have raged at points all the way from the upper Stokhod, below the Pripet Marshes, east of Kovel to the Dniester River, south of Halicz, a distance of 200 miles. On the north the object is Kovel in Volhynia—a railroad center of great importance; on the south it is Halicz—also a railroad center and one of the keys to Lemberg. In the center, where the fighting has been most severe, the objective is Lemberg itself, the capital of Galicia.

The strategy of the present fighting is to cut in two the Austro-German armies; from the strong offensive it is evident that it is being pressed on as large a scale as that of last year, only this drive starts where the other left off. The direct assault at the center around Brzezany has been over a front of 20 miles and was delivered by 16 Russian divisions which, if at normal strength, would number about 290,000 men. The latest accounts of the battles tell of a sweeping victory along the front east and southeast of Lemberg and also that all the power of the Russian forces is being concentrated here in the rush on the capital city. The town of Brzezany itself, 50 miles to the southeast and commanding the upper Zlota Lipa line, has been surrounded on three sides and is being evacuated by the Austrians. To the north the Russians have crossed the Strypa River and are advancing along the railroad from Tarnopol to Zloczof.

Whatever may have happened on this front, two features will stand out prominently. One is that the Russian army has not lost its driving power despite the demoralizing influences of the revolution, for the attacks are being conducted with great spirit and enthusiasm; the other point is that the armies are now well supplied with ammunition. Lack of artillery ammunition has always been given as one of the principal reasons for the closing of General Brussiloff's campaign last year, though it is now also recognized that, due to German influence, his support from the Czar's government broke down completely at that time. He was undoubtedly thoroughly handicapped by court intrigue and constant fear of treachery in his own ranks—difficulties he has no longer to overcome.

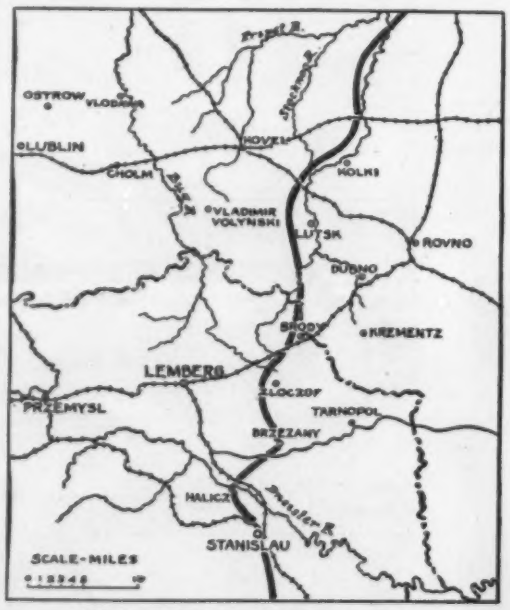
Present developments show that the fraternizing period with the Austrians and Germans has gone forever and also that good relations have once more been established between the officers and men, where suspicion and distrust have for so long a time prevailed. The country is arranging new economic systems; once credit is strongly based, a new era will open up within the country at large and in the military and naval forces. Russia, in fact, by the events of the last few days, has announced her reëntrance to the field of hostilities and with renewed strength. How far that strength can carry her is at present a pure guess; but it represents a concerted action on the part of the new government and definitely ends a partly recognized armistice that has prevailed on this front for months.

The present movement, therefore, has an importance far in advance of results now being obtained by military operations and opens up hopes for the future coöperation of all classes and general support of the new government. It also sounds the death knell of the German hopes and conspiracies that have so long hampered the best counsels of the Russian government; it shows too that Germany and Austria must fight out their battles on all fronts for no new divisions can now be withdrawn to strengthen the hard pressed Hindenburg lines on the Western front. The Teutonic Allies have been caught on their eastern lines with thinned ranks due to the large transfer of troops to bolster up their eastern and Italian defenses. Austria especially is in a bad way, for withdrawals of troops to strengthen the Trentino and Gorizia fronts have so reduced her numbers in the trenches that it is said one division has been assigned to hold 14 miles of lines.

Russia, knowing this, has struck in Galicia. No help can come from Italy where all troops are now needed. Otherwise Italy will strike with full force. Thus, poor Austria is an anvil upon which the heaviest blows must fall. There is a great deal still to be done behind the Russian lines in the way of civil and military rehabilitation. The continued offensive by the army, however, will do much to facilitate this work and to destroy the influences for ill that have for so long a time disturbed all military and civil life throughout the country. Everything now depends on the army and its success in the field; the present drive has done wonders in solidifying popular sentiment in Russia and in strengthening the hopes of the Allies for adequate aid from her in the present struggle.

There is every indication that the German commander on the Western front intends to force the fighting to some decision during the coming summer, for not only are strong efforts being made at various points around the Craonne plateau and in the Champagne region but constant assaults are being made upon parts of the line held by the British and also by the French from the south of St. Quentin to the Oise River. So far as the French are concerned they continue to advance, if only by small degrees; the English also are making progress which, though small in places, is in the aggregate material and decisive. While the German high command is sending out feelers to determine weak points in the French and British lines, probably with a view to higher strategy, fighting is really extending from the North Sea to Verdun and its vicinity.

Official reports state that British troops and guns have been heavily engaged in the vicinity of Lombartzyde which is at the North Sea end of the Allied lines. There are good roads at several points along the beach in the vicinity of this village and of Nieuport that run back to a high road parallel to the coast about a mile or two back. This makes communications easy for the Belgian troops who have heretofore held this line, especially as there is also a railroad running up from Dunkirk in



The battle lines on the Russian front

France through Furnes and Dixmude and on in the direction of Bruges. A railroad extends from Dixmude to Nieuport on the coast and canals extend from Nieuport to Furnes and thence to Dixmude and Ypres; all these furnish good communications for supplying the lines along the front. These lines as stated, have been held by the Belgians and extend as far as Boesinghe some three miles north of Ypres. It has not been difficult to hold the lines as all the country between the railroad and the Yser has been flooded to a depth of several feet, thus effectually preventing any land demonstration. Several times report has been made of French guns in action around Boesinghe but the published announcement is the first information as to the British action in this section.

As the line of operation is followed in the south, it will be noted that here too the British have been at work. They have forced the Germans out of the narrow strip along the railroad leading from Armentières to Menin and are now on the outskirts of Warneton so that the triangle occupied by the Germans between the Lys River and the Comines Canal has been greatly narrowed. As the English are coming down the canal and are also following up the valley of the Lys River, the Germans in the triangle are gradually being drawn into a net which will be closed when the British reach Comines. Should this be done before the German troops escape, they must surrender, which would be one of the greatest blows the German army has yet received. Even if they escape, the British will still be in line for a quick advance upon Lille from the north and upon the great manufacturing centers of Roubaix and Tourcoing.

The British net being drawn around Lens assumes greater proportions as time goes on, for the Canadians have captured Reservoir Hill, another advantageous position about a mile southwest of the town, and have also taken Leauvette. To the south they have gained half or all of Avion. The Germans have dammed the Souchez River and have by that means flooded the country between Avion and Lens; but strongly organized defenses on both banks of the Souchez have been taken or, as described in official reports, "positions of great strength and tactical strategic importance." While "tactical" refers to an advance on Lens, "strategic importance" would refer possibly to lines of defense that extend back of Lens or even farther to the rear. In fact, all the heights in a three-quarter circle around the town render it possible to take the place by assault; but, as the Germans have apparently received orders to hold the town at every cost, the losses would be far greater than will be caused by a gradually enveloping movement that will finally close it up and will prove equally certain in results.

It is evident that the British forces have penetrated the vital elements of the German defense lines by their approaches on the southern side. Avion itself is practically a suburb of Lens; a short distance beyond is the intersection of three of the four lines of railroads by which the German troops receive their supplies. If the British get this junction, the Germans will be cut off from Douai and would have to depend entirely upon Lille much farther away. In that case Lens could not be longer held.

There are three great objectives in the present campaign on the Western front to which the strategical moves of the British forces now immediately apply; these are Dixmude on the north, Menin in the center, and Douai on the south. At present, it is Douai that is the point of interest, for the evacuation of Lens would throw the Germans upon their last defensive line before that city. Menin is over the Belgian frontier and has been threatened by the British advance in the vicinity of Warneton and Comines. Dixmude is the center of the Belgian front and has, along with positions on the Yser canal, been subjected to heavy bombardments, as if it was expected that there would be made a general offensive movement on the part of the British coming out of the trenches heretofore manned by the Belgians.

How different conditions are today on this Western front, especially on that part occupied by the British, from what was the case one year ago can best be learned from a summary of what is now taking place. Just a year ago an advance on the Somme began which was a carefully planned and well executed campaign; it was the greatest attempt that Britain had ever made under arms; for the number of men under arms, the number of men and guns taken, and the tremendous artillery preparation beforehand, were on a scale never before dreamed of. Hopes were high, and, while results were not all that could be expected the move was a splendid training for field work and converted the English amateur soldiers into veterans who, during this present year, have shown themselves the equals if not the superiors of the pick of the German troops. Today the fighting front extends from the North Sea to St. Quentin and British guns, outnumbering the German in the proportion of three to one, are throwing high explosive projectiles on nearly every mile of the 110-mile stretch. The supply of munitions is almost inexhaustible and it has been possible to help out Italy and Russia with guns and shell. Last year the Germans could mass sufficient forces on the Western front to hold the British advance; today they are being slowly but surely driven back after most desperate efforts to avert the danger. The German man-power is no longer what it was and this is shown each day in increasing signs. Possibly the number of men in the field is as great as ever but the spirit of the troops is no longer the same. Victory seems by no means as certain for them and this change of view is not so much due to hunger and want as to the successive checks to German arms and the continued pressure and increasing numbers of their opponents. One great surprise—and a fact not generally known—is that the Belgian army has been entirely reorganized and is today larger in numbers, better equipped, and more determined in spirit than ever before. It should be remembered that this army in 1914, not 100,000 strong, met the Germans who had three times the numbers and held in check for 13 days the great invasion that had been under preparation for years, with the expectation that it would be irresistible. Today the army occupies a front of 22 miles with several divisions of infantry, cavalry and artillery.

It has been somewhat difficult to understand the reason for the continued efforts of the Germans in the Aisne and Verdun sectors of the French line where the French gun- and small-arm fire as well as bayonet shocks have so often shattered their attacks between Soissons and Rheims and the west bank of the Meuse. Each

(Concluded on page 34)

Doing Our Bit—II.

Present Conditions and the Remedy

AT present the ownership of our merchant marine is divided among one hundred or so of companies, some of them big, long-established institutions, others mushroom affairs, grown over-night, the spawn of war-time prices.

With foreign freights at $60 a ton, anything that will float will pay its original cost each trip. Ships have been bought, converted, salvaged, even raised from the bottom to reap their share of the golden harvest.

The Department of Commerce requires each ocean-going steamer to carry eight licensed officers, and the same law demands three years' experience by each applicant for a license. The tremendous accession to American tonnage during the war created a demand for officers which the supply could not meet.

With plenty of positions at hand, and feeling that ship owners were making enormous profits in which they they were entitled to share, the various associations of merchant marine officers increased their standard wages. The possessors of resurrected old kettles were ready to pay almost anything to officers willing to take a chance on their ships, and the big lines had, perforce, to follow. The first raise was followed by another. Then Germany began torpedoing neutrals and again an increase was demanded by those sailing through the war zone. They felt that their lives were being risked in a war which was not their war, and that the Allies should pay through the nose for the service.

In the British merchant marine, of course, the case was different. They were in the war just as much as was their navy. They received a total increase of two pounds per month, and their job was to bring their ships in. Before ships were armed there were many desperate escapes from U-boats recorded, where vessels came into port full of shell-holes, with dead and wounded on deck—but came in, nevertheless.

In one case the submarine shot away the ship's bridge, killing the captain, the first and the second officers and wounding the captain's son, who, as helmsman, doggedly hung on and finally made port. The records of the British merchant marine are as full of sterling heroism as are those of its navy.

When the United States did enter the war, wages still climbed. In addition to a 50 per cent war bonus with insurance of life and effects, a first-class passage home on full pay in case of sinking was demanded and received. There was no incentive to bring the ship through anyhow, no "Damn-the-torpedoes" spirit apparent. Our merchant marine officers, while not lacking in courage, still did not feel vitally concerned in the war.

The conditions with the lower ratings, the seamen and the firemen, are even worse. Probably few not in the shipping business realize that 95 per cent of the men in the forecastles are foreigners, speaking little or no English, bound by no loyalty to the flag they serve, in many cases members of the I. W. W., or equally radical organizations, men whose chief aim in life is a thundering drunk.

After each trip, however short, all hands are paid off and another crew signed on. Frequently each voyage sees not a single man of the previous crew on board again. Even after signing articles the men may refuse to go and a new crew must be found. When the ship does clear, two, three or four days late, it is probable that one-fourth of the forecastle will be in its bunks, "sleeping it off"—on full pay—while the remainder of the crew must be hired to stand the watches of the "hang-overs"—at double pay!

Since the war began the men's wages have tripled, but thanks to the demand for them, and to the power placed in their hands by the Seaman's act, they are difficult to get and impossible to deal with. As an example, a certain ship was informed as she entered the war zone that four submarines were operating in her path. The naval officer in charge of the guns requested that additional ammunition be brought on deck. When the American master of this American ship issued the orders, the crew of foreigners refused to obey on the ground that it was Sunday and they could be required to do no work other than standing watch!

The writer holds no brief for the shipowners; it may be that they are conscienceless "profiteers"; it may be that their previous sins are now being visited on their heads; it may be that they drove the American from their ships by short-sighted policy—it matters not. Whatever the cause the conditions exist, and existing, militate terribly against our mission in the war.

When a liner, good for a steady 19 knots from port to port, barely averages sixteen through the war zone because her firemen refuse to exert themselves, there is something more than the principle of labor-unionism involved; those men are jeopardizing a national asset.

This war hinges on transportation. Yet the Allies have practically abolished their merchant ships.

A merchant ship was free to come and go for her owners' profit. The ships of the Allies go as their government sends them.

A merchant ship was unarmed. Modern vessels carry the battery of a small cruiser.

Merchant ships were subject to visit and search, the flag covered the ship up to one-half the cargo. Even enemy ships were only destroyed after the crew was removed. Now they are sunk without a second's warning.

Merchant ship crews were saved and treated as non-combatants. Now they are exposed to death by gun, mine and torpedo as utterly as are their uniformed brethren of the Navy. They are performing duties which are just as important to the nation as are those of the battle-fleet. They are entitled to the pay and pensions of the Naval services and should enjoy a recognized status as part of the armed forces of the State.

The ships themselves are as much part of the military resources of the nation as is a train of motor trucks. Every ship not engaged in a trade which will best further the prosecution of the war is a handicap. If there were relatively as few railroads in this country as there are ships, every one of them would now be under military control. It is as fatuous to permit large American vessels to junket about the Caribbean with tourists as it would be to side-track a troop train for a shipment of pianolas.

The change has come gradually, but we must recognize the grim fact that nations nowadays are carrying their cargoes in men-of-war. The merchant ship, as such, does not exist. Neither labor nor capital can be allowed to dominate our ships in war; the needs of the nation must come first.

As ships are a military asset they must be controlled by the Government. The private owner should not be allowed to amass a fortune from the needs of our Allies, and he can not bear the cost of making our cargo fleet the efficient machine it must be to perform its duties adequately.

Since the personnel problem is at present the vital one, the ships must be taken over by a military branch, as only those two branches have the power to compel men to risk their lives in war. Naturally, the task will fall to the Navy.

Without a word of additional legislation, as many ships as are needed can be taken as "Naval Auxiliaries." Their officers, as members of the Reserve, would take the status of Naval officers. The same ones who fought for wage increases will serve cheerfully at a lower rate if the difference goes to the country and not to a stock company. Additional officers can be used as they qualify, regardless of length of service or license, because the Navy does not use licenses on its ships.

For the men, it is obviously unsafe to allow foreigners of anarchistic tendencies to man our cargo-cruisers. That condition was eliminated from the Navy and must be eliminated from its auxiliary. The resulting vacancies will be filled from enlisted men of the Navy. The latter, since its increase, can spare enough to man all necessary ships. After a brief "shaking down" every ship will steam faster, load quicker, handle better, and operate more efficiently as a result of the higher standard of personnel and its permanence.

Although the control of the cargo fleet is thus put in the Navy, the real operating of the ships should only be handled by an expert shipping man, or by a small board. Naval officers are excellent on men-of-war, but such a job calls for a business man who knows his business.

By such amalgamation of the Naval auxiliaries not only is an increased efficiency of ships and of service attained, due to the centralization, but an intimate coöperation with the Navy is achieved. Delays for pilots, examination and quarantine are obviated, information leaks are reduced, communication facilitated and convoy operations are simplified.

In addition, a well-nigh perfect flexibility is assured. A ship may be a transport one trip, a supply ship the next, and an armed cruiser the third, all with the same crew. No strikes, no delays, plenty of men and good coal for fast runs, intelligent lookouts, enthusiastic officers, *esprit de corps*—these are only a few of the advantages apparent in the immediate present.

Besides these it must be remembered that as the ships are only taken for the war, so, too, the men on them will leave the service when peace is declared. Some of these fine young Americans will return to their homes, but they will always retain an intelligent interest in the American merchant marine. Others will stay on the ships, satisfied with the sea as a career.

In either case they will directly aid in getting the "sea-habit" again into America, and in laying the foundation for an enduring native merchant marine on which alone we can rely to meet the maritime rivalry which is sure to come after the war.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Submarine Problem

To the Editor of the SCIENTIFIC AMERICAN:

Now that the submarine menace, and the problems connected with it and their solutions are occupying the minds of such a large proportion of our population technically inclined, or otherwise, it might be timely to gather together some of the suggested possibilities in the way of solutions of these problems which have, here and there, and from time to time, been proposed.

Subjoined is a table of some of the possible modes of attack on the problems in question gathered together by the writer from various sources in recent months:

No. 1

Submarines under construction in German and Austrian Ship-yards

(a) Location.
(b) Destruction.
(c) Special curtailment of the supply of essential materials.
(d) Harassing operations.

No. 2

Submarine Bases

(a) Detection.
(b) Destruction.
(c) Traps.
(d) Blockading

No. 3

The Submarine

(a) Detection (by sound, electricity, photography, etc.).
(b) Destruction.
(c) Blinding (periscope, etc.).
(d) Asphyxiation of personnel.

No. 4

The Torpedo

(a) Detection.
(b) Premature explosion.
(c) Deflection.
(d) Stopping.

No. 5

Mine Strings

(Towed across ship's bow by submarines.)

(a) Detection.
(b) Destruction.
(c) Dragging.

No. 6

Vessel Attacked

(a) Invisibility (smoke clouds, etc.).
(b) Protection from torpedoes and mines.
(c) Unsinkability.

If even partially effective measures could be found covering the majority of these suggested lines of activity; or wholly effective measures covering one of these lines, the submarine menace would soon dwindle to unimportant proportions.

Ideas in many of these directions have been, and are being worked out, but it is hoped that this list may suggest new lines of activity to some of the competent brains of the land.

WILLIAM C. KOCH.

St. Paul, Minn.

Fighting the U-Boat from the Air

To the Editor of the SCIENTIFIC AMERICAN:

Having been a reader of the SCIENTIFIC AMERICAN for several years and noticing an article, Fighting Submarines from the Air, I would say that my plan would be to have huge floats big enough for several planes, anchored in desirable places and used as a base for the airmen who would do picket duty. These floats could be well protected with small guns and could also serve as a base for the small submarine chasers. Mother ships could serve several miles of floats in one day.

J. F. BEGONY, M.D.

Hinton, W. Va.

A Problem of Identity

To the Editor of the SCIENTIFIC AMERICAN:

I thoroughly believe in the submarine freighter, and had suggested its possibility two years ago, when Germany gave her first hint of "ruthless warfare." The difficulty, however is this: The majority of freighters will remain surface boats; the seas will still be infested with German submarines. The duty of all armed vessels, will be to shoot at every periscope that peeps above the waves. Therefore, some method must be devised whereby our friendly submarine freighters can escape the projectiles meant for the German U-boats. This is not an engineering but a tactical problem; it is not insoluble, but ticklish. Many of us would try our hands at it.

A. L. GUÉRARD.

Houston, Tex.

Pictured Physiology

How Study of the Human Mechanism Is Made Popular for Young Readers

THE human body affords a fascinating study but, unfortunately we are prone to leave this to our professional adviser—the doctor. Physiology is seldom made attractive to the young. Hence it was with a start of surprise that in looking over a set of books for giving visual instruction to the young, we came upon a chapter in which the human body was treated as we had always wanted to see it treated—as a machine or rather as an aggregation of machines. The illustrations were prepared under the direct supervision of Dr. Winfield Scott Hall, Professor of Physiology, Northwestern University Medical School, so that the scientific accuracy of the analogies is assured. There are twelve illustrations in the entire series, but space forbids using more than the five here shown.

A look into "headquarters" is not intended to be a pun, but to give a view of the functions of eyes, ears, nose, mouth and brain. All orders start from the so-called "main office." When we decide to go somewhere, for example, this part of the brain tells the legs to move. The order is passed on to the assistant who sees to it that we go on walking until the "chief" tells us to stop. The figure in the switch room looks after the work that goes on unconsciously—such things as the beating of the heart—and actions that we can control partly, such as the motion of the lung bellows. The "memory file" is a pretty conceit and bears out what Napoleon used to say about thoughts being stored away in the drawers of his mind. The wires (nerves) which descend to the limbs are represented as running through a brick well. In reality the vertebrae protect the spinal column in much this way.

"The Community Mill"—getting ready to grind up a piece of bread and butter

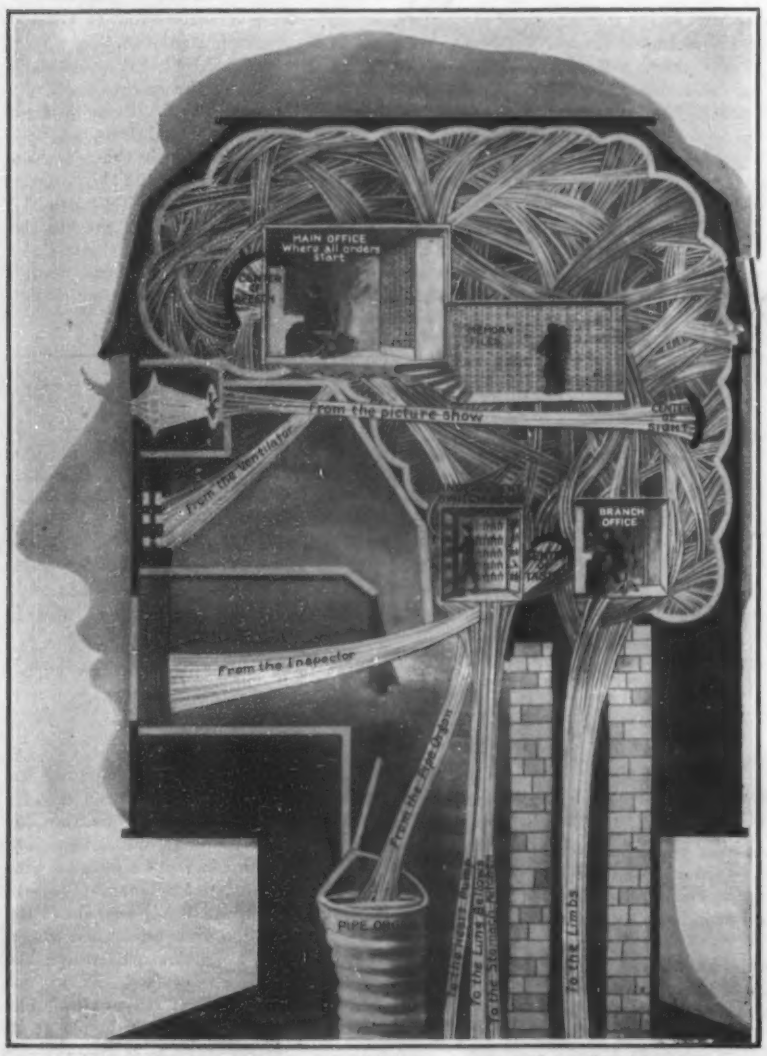
The artist did not wish to overload his drawing with too much detail so he makes a special picture of "The Community Mill." Here is graphically portrayed some "grist" being brought to the mill—a nice piece of bread and butter. The sharp choppers cut it into large blocks. If it were a piece of meat the shredders would tear it up. Notice that the little inspector who represents the sense of taste in the tongue is right on hand to see that the grist is of good quality. On either side are the tubes leading from the saliva laboratories, and these begin pouring saliva on the food as soon as it gets into the mill and continue until it passes out and into the kitchen. The grist keeps getting finer and finer as it proceeds on its journey, being treated first by the coarse grinders, and last of all by the fine grinders. All this time the little mixer, the tongue—represented by the figure with the shovel—is turning it over and over and passing it back and forth so that the digestive saliva may be thoroughly mixed with it.

One of man's greatest problems has been how to supply pure air to buildings, and in winter, how to warm them. This picture illustrates how perfectly nature solved the problem for man himself. The air we breathe through our noses is compelled to go through those crooked passages, so that it is not only warmed in winter, thus protecting the delicate tissues of the lungs, but the impurities in it are collected on the hairs that line these passages. When we breathe the air out it goes by a short, straight route because we need to get rid of it with as little delay and effort as possible. The insert picture in the lower left-hand corner shows what happens when we breathe through the mouth—the air comes straight in, carrying all its impurities directly into the lungs.

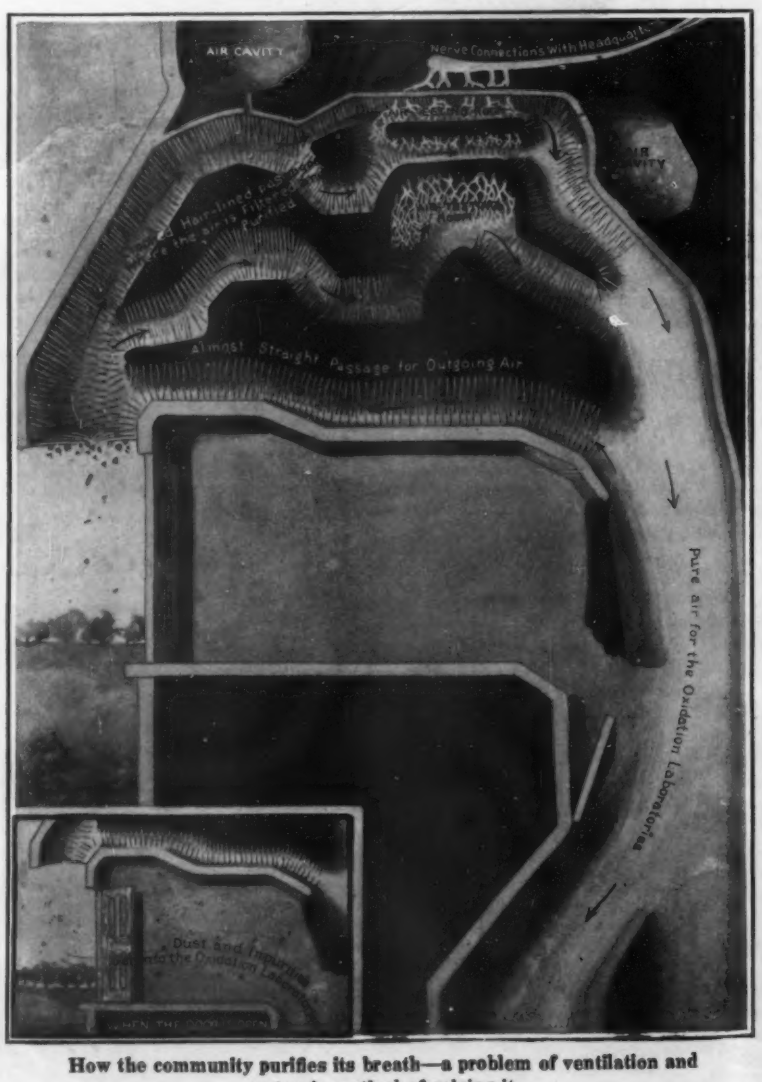
In a trip through the "Food Factories," the artist has so surpassed himself that we can really see proteids and the fats and the starches going through the mill and slipping down to the kitchen. Here we are following some food through the community kitchens—an egg, a piece of lean meat, some starch, potato and a slice of bread. The egg and the meat are shown just as they come to the "mill," unground, although of course we grind everything that comes into the "mill." The digestion of foods of this kind does not begin in the mouth, as is the case with a large part of the bread and potato eaten. The other food, after being acted upon in the first kitchen below, will be passed to the second kitchen, where the bile and pancreatic juice complete its digestion. Finally it passes into the long tube, where the little fingers in the walls sort out what the community can use, the waste going into the sewer.

The food when prepared must be marketed. We have called this picture "The Pure Food Delivery System," because it shows just how the food of the community is purified and then delivered to the different members according to their needs. Notice here that the community kitchen, called the stomach, is shown in its natural position. It would be necessary to turn the bottom of the kitchen up, as it is in the preceding picture, in order to see the pancreatic juice factory.

We are indebted to the courtesy of Mr. Francis B.



A look into "headquarters"—a fanciful but accurate and graphical representation of the activities of the brain, eyes, ears, etc.


AIR CAVITY
Nerve Connections with Headquarters
Almost Straight Passage for Outgoing Air
Pure air for the Oxidation Laboratories

How the community purifies its breath—a problem of ventilation and nature's method of solving it

Atkinson, Managing Editor of "Pictured Knowledge," published by the Compton-Johnson Company of Chicago, for our ability to show these remarkable pictures to our readers. These volumes are brimful of ideas and pictures. They make us wish that we had had such books when we were young, and the appeal which they present to those of older growth can readily be gaged by the concrete examples presented herewith.

German Military Aeroplanes

IN aerial warfare constructional and other details of the aeroplanes used by either side cannot be kept secret for long. Machines are constantly being captured or shot down by the enemy; and although the pilot or crew of a vanquished aircraft have instructions to destroy it immediately upon reaching the ground, it often happens that there is little opportunity to do so. Consequently all parties in the present European conflict are fairly well informed of each other's air-strength as regards types and capabilities of the different machines used and their armament. Owing to the slightly relaxed censorship in Great Britain it is possible to glean a few details of some of the latest German aeroplanes which from time to time have fallen into the hands of the Entente.

Although the present war is not the first time that aeroplanes have been used for military operations, yet on previous occasions—notably the Balkan campaign—their use was confined solely to scouting activities; hence there was no special type of war-machine necessary. In operations like the present conflict, many new and specially adapted aeroplanes have been evolved. Roughly speaking, war (land) machines may be divided into five classes: fast two-seaters for reconnaissance, carrying an observer and photographic outfit; artillery spotters, whose duty it is to hover over the enemy's lines and spy out his hidden batteries; large weight-carrying machines with no special turn for speed for bomb-dropping; battle-planes, or chasers as they are sometimes called, whose object is to attack and repel the enemy's aircraft; and finally a hybrid type of plane, known as a gun-carrier, of more or less heavy armament, whose mission it is variously to escort squadrons of bomb-droppers, drive off hostile chasers, and even occasionally attack the enemy's infantry.

At the commencement of the war it was evident that Germany had a large number of monoplanes of the well-known *Taube* type in use on the Western front. These machines, though possessing a good deal of inherent stability and capable of standing much rough usage, are not very speedy, even when fitted with the excellent 100 h. p. Mèrcedés engine. They are of various makes, chief among which are the Rumpler (Etrich), Albatros, the "Steeldove" type, Gotha, and D. F. W. Most of these machines were built of steel tubing, and on account of their huge wing-spread were braced with king-posts and a light girder arrangement under each plane, besides having exceptionally strong and consequently heavy landing-chassis. The majority of them had ailerons instead of the usual warping wing-tips—an exceptional feature on a monoplane. It is therefore difficult to see how they prevailed against the lighter and swifter machines of French and English make. Whatever their strength and gust-resisting capabilities were, there can be no doubt they were sluggish and difficult to maneuver quickly in the air, This the writer can vouch for by personal observation.

But the Germans are not a people to be content for long with an unsatisfactory article. According to advices from the front there are much fewer *Taubes* in operation now than formerly. Not that their use has been done away with entirely; but they have evidently been found unsuitable for work requiring great speed. Photographs of the latest Rumpler *Taube Eindecker* (monoplane) show many alterations and improvements over the earlier type. Noticeably, the doing away with the girder structure under the wings and the substitution of a hinged elevator for the flexing tail. The wing spars and fuselage longitudinals are now made of wood (ash) instead of metal tubing. Fitted with a 100 h. p. Mèrcedés engine with a light aluminum Windhoff radiator overhead, this machine is said to climb 800 meters in six minutes, and to fly horizontally at 74 miles per hour.

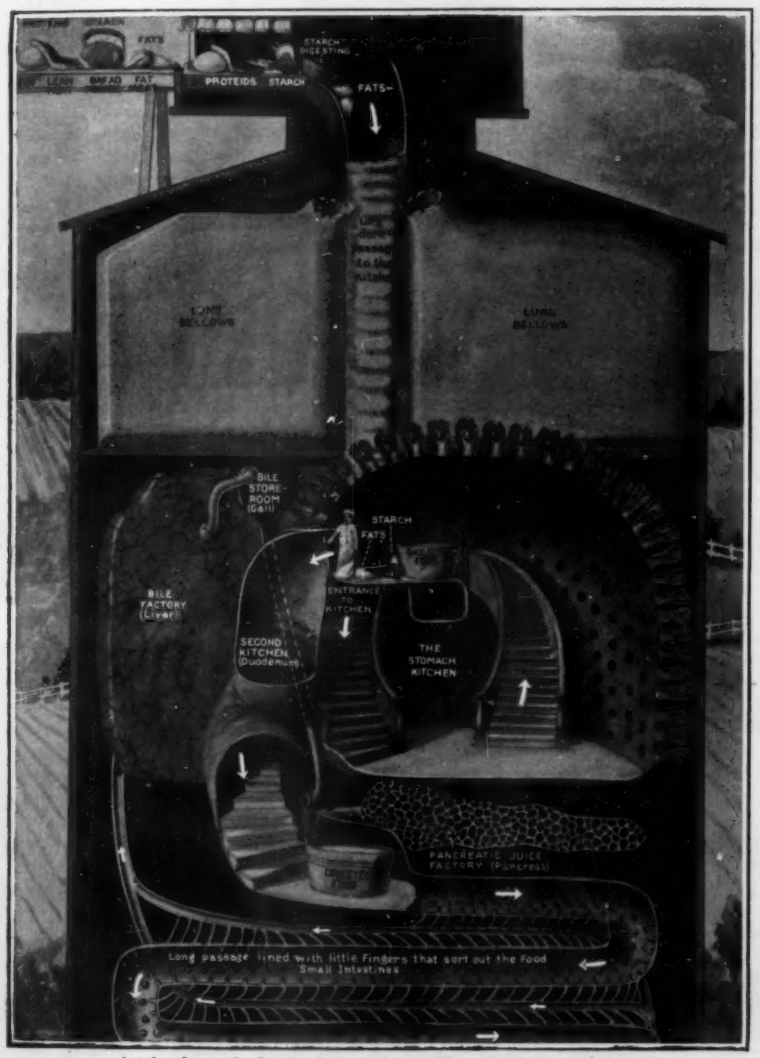
The various biplanes (all of the tractor type, such as the D. F. W., Aviatik, L. F. G., and Albatros) in use by the Germans before the war, were in such a high state of efficiency at that time, that it is doubtful whether they have undergone much development beyond the substitution of more powerful motors. Their chief characteristics were their diverse ranges of speed, their simple yet strong undercarriages, and the excellent braking devices most of them carried in the shape of a claw-like skid which allowed them to be brought to a standstill in a small area—a most valuable asset in wartime, where landing places are often restricted in size.

Aeroplanes driven by tractor screws in front of the machines have always proved themselves more efficient in speed, climbing powers and other ways than those having the propellers behind. Unfortunately, the former class have the disadvantage of restricting the view both of pilot and observer, besides interfering to a great extent with gun-fire in a forward direction. Sketches of a late type of biplane show the Germans have increased the range of fire possible by fitting a light machine-gun or automatic rifle with the muzzle projecting through the top-plane, and the breech and operating mechanism within reach of the gunner's or observer's hand when standing up. This enables him to cope with any hostile machine either directly above or at a vertical angle in front within an arc of about 80 degrees. A machine-gun is also mounted in the cockpit, not only commanding an enemy on both sides, but also, by means of a tube running backward through the floor at an angle of about 45 degrees, allowing the gun to be fired at a pursuer beneath, or, by a little maneuvering, the discharge of a belt of ammunition upon one directly behind. The latter would be impossible in an ordinary machine on account of the danger of riddling one's own tail with bullets.

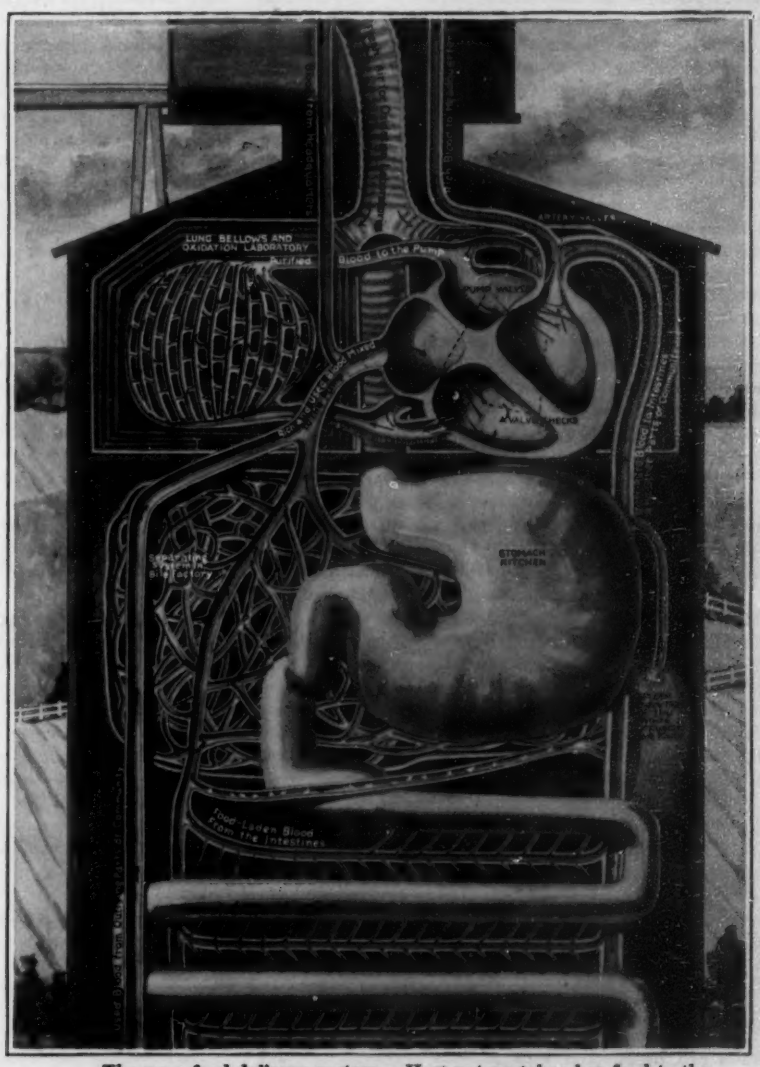
A gun of large caliber cannot be operated successfully on a tractor machine; and all parties use "pusher" biplanes for this purpose. One of the chief German planes of this type previous to the war was the Ago, in which the gunner sat in front of the pilot, having a clear and unrestricted view and range on almost every side. Probably at this date they have large twin-engined machines with double fuselages, or "two-tailers," with a small nacelle in the center. The Italians are already employing with great success a biplane on these specifications known as the Caproni.

So far the most sensational surprise the Germans have sprung upon their opponents in the air has been the Fokker machine. This little monoplane with a span of only 12 meters is an adaptation—or imitation if one likes to call it so—of that well-known French machine the Morane-Saulnier. Built of steel throughout with the exception of the wing-spars and ribs, its graceful lines and general simplicity are in great contrast to the usual *Taube* type. Fitted with an 80 h. p. *Oberursal* rotary engine, which is practically a German-made Gnome, the sides of the planes bordering the body are cut away a few inches both forward and behind the wing-spars to increase the view of the occupants. There are also small openings on each side of the front part of the fuselage, protected by windscreens, which enable the observer or passenger to fire laterally. Carrying a machine gun which could be fired directly

(*Concluded on page 33*)



A trip through the food factories.—How the tremendous waste is made up



The pure food delivery system.—How nature takes her food to the ultimate consumer

A Business Shock Absorber

How the Commercial Economy Board of the Council of National Defense Is Teaching War Economics

By C. H. Claudy

WHEN the first cave man heaved a rock at his fellow, war began.

When the first tribes of cave men fought each other, *organized* war began.

Since that time, each succeeding stage in the art of war has been a greater and more inclusive development. Early wars were but little more than thousands of single combats taking place at the same time. Came a better organization, the beginning of strategy, and company fought company, regiment fought regiment, as a whole.

With gunpowder and the rifle putting distance between enemies without prejudice to their power to injure each other, strategy developed and became preëminent, and for the first time armies fought armies, as a whole.

Then came science, and every war which has taken place within the last hundred years has seen a higher development of the mechanical, explosive, instrumental side of war.

Finally, came the greatest of all wars, to show as a present fact the foreshadowings of previous conflicts—that warfare is now not between soldiers, singly, in regiments or even in armies, not between generals, with victory going to him who has the greater strategy, not between the hired armies which peoples pay to do their fighting, but between nations, *as nations*.

It is not because her armies are braver, not because her soldiers are better equipped, not because her generals are abler, nor even that she is fighting a ringed-in, defensive fight that Germany has managed so well to withstand the combined onslaught of so many enemies, but because her industrial organization, however much we may decry it as undesirable in times of peace, is so splendidly adapted to make the whole German nation a solid unit, with every man, every woman, aye, every child, doing a part; with every personal pleasure, every individual liberty, circumscribed and directed toward the one end—victory.

The hardest lesson England had to learn was that "Business as Usual" was *not* a good war slogan. She kept "business as usual" as long as she could—until the commercial situation became acute. Then she readjusted, violently, quickly, with a wrench and a jar which shook her industries to the foundation, and was felt even to the fighting front.

If the Council of National Defense can have its way, there will be no such violent commercial readjustments in the United States, no matter what changes and alterations our participation in the war may bring to business. There will be no such shock, because a shock absorber has been provided in the Commercial Economy Board, A. W. Shaw, Publisher, Chairman.

The general public as yet knows little, but is destined to know much in the future, of the workings of this board. It must be obvious to every thinking man that if a million or so men, an untold quantity of material and money without stint are diverted from peace uses to war, the body must suffer some sort of derangement, *unless* such withdrawals and divisions are made so guardedly, so wisely, and so carefully, that the shock is minimized, the derangement corrected almost before it has begun.

This, then, is the work of the Commercial Economy Board—to determine what readjustment in business and trade can be effected with least injury to trade and business—to educate the public, as well as trade and business, to accept these readjustments and to release for essential work that material and those men who can best be spared without working a hardship to the nation, the manufacturers, the consumer, and the business which makes the money by which the war is financed.

The program of the Commercial Economy Board is sharply divided into two classes. One, the immediate things, for which there was a crying need—two, those which can only take place through a somewhat lengthy educational campaign, and which, while highly important, are better accomplished by time than by immediate action.

As an example of the first class of work, the saving of 3,000,000 bushels of wheat, htherto wasted in the grinding up of unsold bread, not to mention the sugar, butter, lard, fire, labor and double hauling which made returned bread the most expensive chicken food in the world, may be considered.

By July tenth, according to reports from all sections of the country, the bakeries of the United States, practically without exception, will have ceased accepting returned bread from merchants. Merchants will order only what they know they can sell, and the housewife who wants bread will have to say what she wants the day before, with the result that no bread will be wasted, no bread will be hauled to the retailer only to be hauled back again, no bread will be baked to be squandered on chickens which would thrive as well on raw corn. In short, three million bushels of wheat will have been saved for human consumption, and labor and material costs have been reduced by 4 per cent in the baking industry.

Such a work has taken time and effort. Traveling agents interviewed master bakers in big cities. Other bakers came to Washington for a conference. A question schedule was sent to representative bakers all over the country and the facts ascertained.

Were this Germany, a government edict would at once have stopped all waste. But this is free America, not autocratic Prussia. The Commercial Economy Board had no direct power to enforce its recommendations. It was depending on facts—and the patriotism and common sense of American bakers. It was a test—perhaps as sharply defined as any yet seen—as to whether American free business could do for the country what Germany did long ago by the same authority which forbids cuffs on trousers, pleats on coats, which dictates the number of pairs of socks a man may purchase and tells his wife how many suits of underwear she may possess before her wardrobe becomes "verboten."

If you are curious as to how the bakers are planning to meet the test, go to your bakery after July tenth and try to buy "returned bread" for your chickens.

Hoover says this is a "wheat war." Hence, this saving of the precious wheat—*enough to feed the first two hundred thousand soldiers we send to France*, be it noted—was the most immediate problem before the Board.

But the second, now being solved, is hardly less important.

We must take men for the army from *somewhere*. The "where" must be that point from which they can best be spared. Obviously not from agriculture, from munitions plants, from ship building plants, from productive industry generally. But if not from industry, from where?

"From least essential work" answers the Commercial Economy Board. Find the unessential activity, and eliminate it—the men released can either fight, or take place of those who can.

To this end the Board has made an extensive and exhaustive investigation into the question of free delivery of purchased goods. Agents have studied typical stores in six of the great cities of the country. Five hundred retail grocery and a thousand retail dry goods and department stores have answered question schedules sent out to them. Two State Defense Councils have aided with statistics and the National Wholesale Grocers' Association has put information regarding coöperative delivery systems in thirty-five cities and towns at the disposal of the Board.

The net result is the disclosure that an army of over two hundred thousand men is employed in rendering free delivery of goods as a part of the "service" given by merchandisers, and that without any very serious inconvenience to either store or public, *over one-half of these could be realesed for military duty or other important and constructive work*.

To accomplish this means cutting down four or five store deliveries to one a day, a better system of routing, coöperative delivery between many stores where such is commercially practical and an education of the buying public, largely women, that the empty-handed shopper is hurting her country—that small packages personally carried home are visible evidences of patriotism.

Add to this the results obtained from a careful investigation of the "returned goods" privilege, which shows a fearful abuse of the "service" which has grown to hydra-headed proportions because of a too severe spirit of competition and a too great demand for ease in buying from the public, and the Commercial Economy Board finds itself in a position to recommend reforms which, once made, will materially lessen business costs, as well as aid the United States in withdrawing men for military service without injury to industry.

It is important to realize that hardly a suggestion or a reform proposed by the Board is a new, a radical, or a contested one. The changes are inevitable, in time. The "shock absorber" wants to *speed up the time*, in order to effect the savings now, when they are needed, but in no case is it proposing revolutionary alterations in trade customs or habits which are not already foreshadowed by the very men who are responsible for the present conditions.

Wheat—men. These were the immediate essentials, the tasks to be done as soon as possible. For the future, the Board is attempting to indicate economies which will largely affect the entire nation, and by anticipation, to effect such economies without undue disturbance of business.

In attempting to influence such matters as style of clothing and footwear, the Commercial Economy Board is working for 1918—not the present. It is highly desirable that the present manufactured supply of all sorts of personal necessities be used. They represent—these suits of clothes, pairs of shoes, yards of cloth, suites of furniture, collections of kitchen ware, automobiles, umbrellas, books, everything—they represent not only material but *labor*. To be effective, the article—material and the labor which formed it—must be bought and used.

But when the present stocks are used up and must be replaced—then is the time for economy.

It is an overworked and abused word—economy. As the Commercial Economy Board uses it, it does not mean denial of anything but the unessential. The Board is not trying to put the country in uniform. It is not trying to eliminate anything that will be seriously missed. It is proposing—and the proposal is meeting with an enthusiastic reception—to lessen the needlessly numerous types of cloth, clothing and shoes.

The proposition is not visionary. When any organization can assemble in one room representatives of the national associations of woolen and worsted manufacturers, of men's and women's garment makers and of retail clothiers, it is able to determine facts in far less time than by any correspondence campaign. Such a conference was recently called and held by the Commercial Economy Board, with a result that cloth factories have been asked to make no more samples for the 1918 trade than *can be profitably sold*. This means *one fourth* to *one tenth* the *usual* number in some mills! Similar suggestions have been made and accepted by the cutting-up trades, with the immediate effect of releasing much needed wool to the government, cutting the costs of doing business, allowing business men to turn their capital over more quickly and therefore to release some of it for war purposes, not to mention the men, hitherto engaged in these industries, now to be released either to fight or to take the place on other work of those who can don khaki.

In addition to work among manufacturers, educational work through motion pictures, newspapers, magazines, store signs, pamphlets, women's organizations and other means is being actively carried on. Practically all the State Councils of Defense, the Woman's Committee of the Council of National Defense and the Committee on Public Information are actively coöperating.

The Board is suggesting economies in other lines besides garments and shoes. It is, through many committees formed by various businesses to aid it in its work, attempting to send its economy probe in many commercial recesses. It is to invade the very business office itself, a special committee of ten leading credit men of the country lending itself and its services free to determine what office economies can be effected and how business, as distinct from manufacturing and production, can save time, money and men, that labor, cash and time be placed at the disposal of the country.

The Board is impressing everywhere the fact that war means *real*, not *fancied*, economy—that making the economies *in advance* means taking up the shock of the readjustment all the warring nations have had to endure, *before it comes*—in other words, eliminating the shock entirely by readjusting before the necessity demands.

And, *business is coöperating*. Whether because we realize that we have more at stake than ever before, or whether, as the Commercial Economy Board feels, the real patriotism of American men is actively in play, matters not. Prussia works its reforms and gets over its readjustment shocks by imperial edict. America is doing the same thing by suggestion, by education, and by coöperation. It is autocracy against democracy, not only in the trenches, but in civil life, and perhaps no triumph the Board has had or will have, is or can be greater than the undoubted fact that in every case where it has offered a carefully thought out suggestion founded on complete investigation, it has met not only with the willing, but with the enthusiastic coöperation of the American manufacturer and business man.

Utilization of Peat and Brown Coal

NOW that it is possible to convert inferior fuels, such as peat and brown coal, with a relatively high degree of efficiency into gas by generators and to make practical use of them as sources of power, the interest in them is increasing. In northern Germany, where water power is not easily available, the high and low bogs are destined to furnish the fuel needed for the generation of electricity. The experiences of the overland power plant in the Aurich er Wiesmoor have proved that with a peat consumption of 2 kilos (4.4 pounds) per kilowatt hour the peat bogs are an economically useful source of power of great extent and duration.

Submarine Problem—VII.

The Zig-Zag Course as a Defense Against Submarines

IN the popular mind, "zig-zagging" is associated with the efforts of a steamer to escape after she has been sighted and attacked by a submarine; in other words, zig-zagging is regarded as a sort of runaway forlorn hope—the maneuver by which the sorely beset steamer tries to get out of the way of the unerring flight of the torpedo. As a matter of fact, if ship captains obeyed instructions they would commence to sail zig-zag courses as soon as they entered the submarine zone and would keep it up until they were safe in port. Unfortunately, the skipper of your tramp steamer is a very conservative kind of a fellow, not given to changing his habits unless he can see the very best of reasons for it, and he is always in a hurry to make port on as direct a course and at the best speed at which his slow-turning engines will shove him along. The sea is wide, he argues, and submarines are few; zig-zagging is a nuisance anyway and is liable to throw him into confusion as to his true position. Hence, too often he lays a course for home which is as straight and true as that of the torpedo which sinks him.

Today, zig-zagging has a protective value which it did not have before merchant ships were armed. Now that the tramp is apt to carry a rapid-fire gun of from three- to six-inch caliber, the U-boat, once it has come within the effective range of the gun, must stay below. In the old days, a submarine with fourteen to seventeen knots speed did not hesitate to run down its prey on the surface, and a large proportion of the victims were sunk by gun-fire. But when merchant ships began to mount powerful guns with Navy-trained gunners behind them, the sinking, even of slow tramps, became a very difficult and hazardous task. Because of its limited storage capacity, the U-boat is using smaller torpedoes than those carried on the battleships, and torpedo speed and range have been sacrificed in favor of an extra-large charge of explosive in the warhead. The U-boat commander prefers to get within one thousand yards of a ship before he attacks, and, if he can make it, he will get within five to seven hundred yards. The preferred position for attack is about two points forward of the beam. On sighting an approaching ship, the submarine heads to intercept her course, submerges, and then takes an occasional look at her, bringing its periscope above water for a few seconds only. The U-boat commander estimates the speed and course of the ship; submerges, and lays his own course by compass while below, so as to bring his boat within torpedo range at a point, preferably forward of the beam.

Now, if, while the submarine is below, the merchant ship changes her course, say through an angle of 45 degrees, the former, on coming up for a few seconds' look at the ship, finds that, instead of converging to meet him, the merchant ship is sailing in a direction entirely different from that on which his calculations were based; his maneuver for getting into firing position goes for nothing, and he has to try again. Unless he is satisfied that his guns can greatly outrange the enemy, the U-boat commander does not dare to use his surface speed, and below the surface he has not sufficient speed to overhaul the merchant ship. One or two misjudgments of this kind will lose so much time, that the ship will have a good chance to pass him and steam beyond torpedo range; indeed, it will soon have gained a lead which the U-boat cannot overcome, except by coming up and using his surface speed.

We have referred to the reluctance of many steamship captains, especially the captains of tramp steamers, to go to the trouble of zig-zagging. Not only is more distance covered, but the navigating officer may forget to make the change of course from one leg to the next at the proper time, and so throw the whole zig-zag into such confusion that the ship will not know where she is with regard to her true course. In order to prevent this, and with a view to making the running of the zig-zag course popular with ship captains, the first officer of one of the large British merchant ships has invented the simple and very effective "zig-zag control board," which is herewith illustrated. It consists of a board about two or three feet square, carrying in its center a clock, and on each side of the clock a series of alternate green and red cards and glow lamps, each card and lamp corresponding to the starboard and port courses on which the ship is being navigated at any given time. Above the clock, extending across the head of the board, is plotted a zig-zag course which it will take the ship one hour to cover.

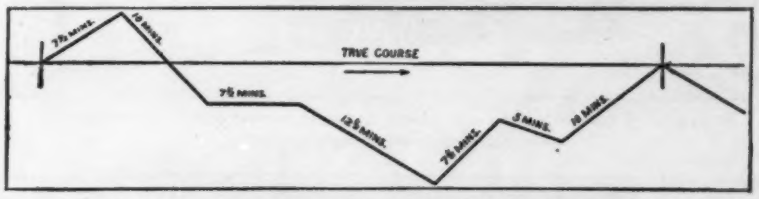
In the case shown in our drawings the straight line represents the true course which, in this case, is, let us say, due north. The ship commences her zig-zag course at, say, 2 o'clock, at which hour the helm is thrown over and the ship's course is altered 30 degrees to port of the true course. She continues on this course until seven and one-half minutes past 2 o'clock, when the minute-hand of the clock makes electrical contact with a bell which rings loudly, announcing that the time has come to change course again. The helm is now thrown over, and the ship is put on a course 45 degrees to starboard of the true course. This course is maintained for ten minutes, when another electrical contact is made, the bell rings, and the ship is turned the necessary number of degrees to port until she is on a northern course, parallel with her true course.

There are seven changes of course during the hour, at the end of which, the ship is back again on her true course. In this particular zig-zag, a 12-knot ship loses two knots of distance in one hour, which represents a loss of about fifty miles in the twenty-four hours; but it is better, surely, to lose fifty miles of distance than to lose the ship. When the bell rings for a change of course, the navigating officer on the bridge pulls out a plug in a circular ring surrounding the clock and moves it to the next hole corresponding to the next change of course. The bell continues ringing until each change has been made; so that the risk of error is practically eliminated.

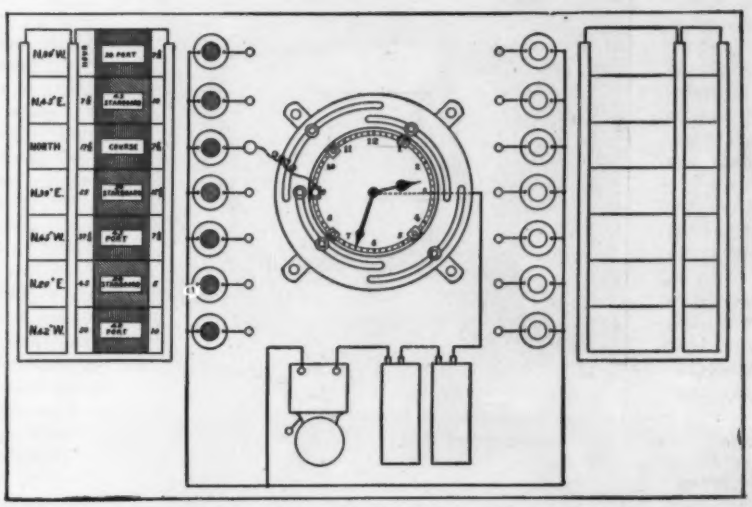
The course herewith shown is a purely suppositious one. The navigator can plot any course he may desire in a few minutes' time, and having done that, he has merely to shift the plug from hole to hole around the periphery of the clock, in accordance with the zig-zag as plotted.

From this description it will be evident that the zig-zag is the concomitant of the gun in this defensive warfare. If the ship is armed, the submarine must stay under and its observation through the periscope, in any but the roughest weather, must be of very limited duration. With a good watch in the crow's-nest and on the bridge, with a well-trained gun crew, a ship which uses this method, even though she be only a 10-knot tramp, will stand an excellent chance of getting safely through the submarine zone.

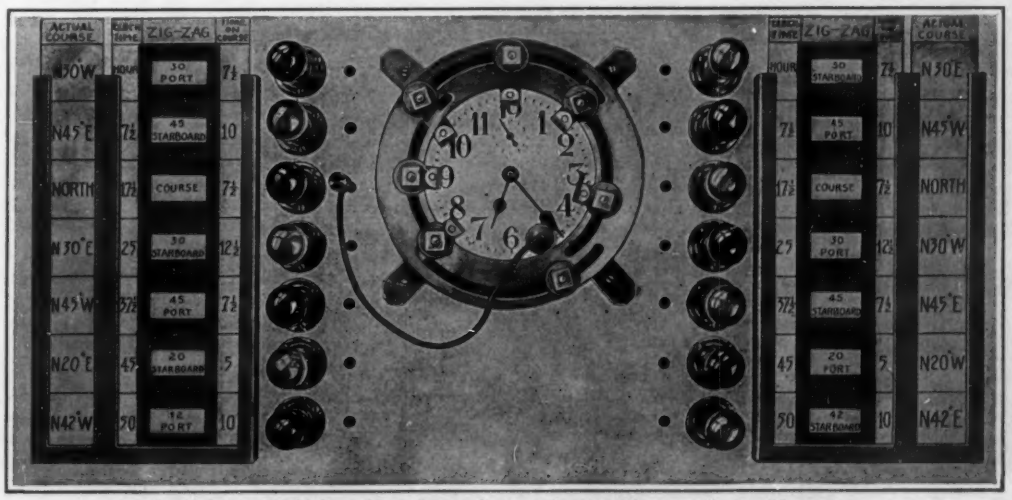
Furthermore, if the officer of the watch, is careful to shift the plug at every warning of the bell, he may be certain that when the hour has expired, the ship will be back upon its mean or true course.



Typical zig-zag course pursued by a vessel in the submarine zone



Electrical connections of the zig-zag control board !



Control board which notifies the navigator when and how to change his course

Radium for Everybody

A PROMINENT physician, writing in a medical journal, recently remarked that the majority of physicians were fairly comparable, as far as their exact knowledge of radium was concerned, with the motorman who, when asked whether he knew what electricity was, replied with complete confidence that it was the juice that made the car go. If this be the case, we may be pardoned for reminding the reader of the rôle which this element plays in the practice of the day.

That radium is not an absolute specific for cancer or for anything else, especially in an advanced stage, goes without saying; and persons with long standing ailments which have been persistently neglected, or which have defied all other treatments, should not fall back upon radium with any other thought than that it represents merely one more chance. But that the still imperfectly understood emanations which radium throws off will in many cases benefit and in some instances cure old wounds and sores which refuse to heal, cancers, tumors, skin diseases of various sorts, rheumatism and other muscular and joint troubles, is demonstrated beyond question. Even deep seated malignancies to which the surgeon would fear to apply the knife lest he kill the patient are frequently benefitted to an extent which makes a successful operation possible.

But ordinarily radium is a curative agent which only the very rich can afford to use, and even they have had in many cases to go to Europe to find a hospital or a physician possessing a supply sufficient to be of value. For unless an adequate supply of radium be used in a given treatment, the material has to be applied for an extraordinary length of time. In many cases this is impracticable. One must have a sufficient quantity at hand, or one might as well not try at all.

Few physicians, individually, few institutions for that matter, possess enough radium to treat satisfactorily even the lesser run of ordinary ailments. For be it known that radium costs in the neighborhood of a hundred dollars per milligram—something like three million dollars an ounce. No one likes to tie up that much capital in so unusual a material, even though he have the capital to tie up. Then, too, hardly any physician has enough radium cases in his own practice to get the most efficient use out of a supply of the metal. To have enough of the substance on hand to treat a large cancer, and to have only occasionally such serious ailments to treat, is obviously a summit of inefficiency inaccessible to the most liberally endowed foundation.

(Concluded on page 35)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Measuring Temperature by Comparing Known and Unknown Thermo-couples

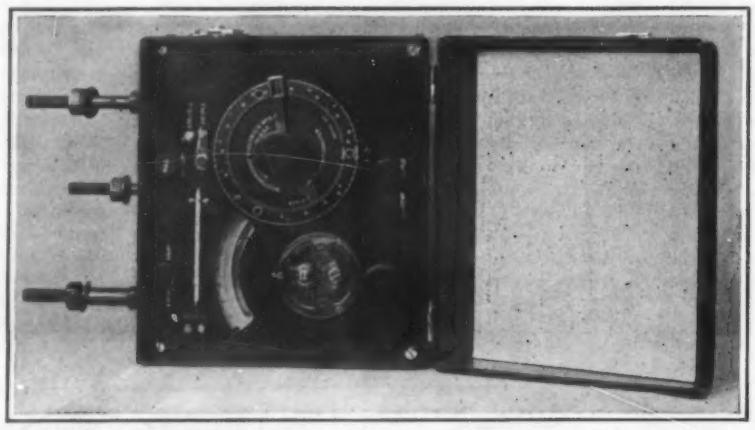
By William H. Easton

IT is frequently desirable to determine the temperatures of points that can not be reached by thermometers. Thus, knowledge of the temperature at the center of a coal pile will give immediate warning of the danger of spontaneous combustion; the temperatures of the inside windings of the coils of electrical machinery have an important bearing on the performance and life of the machinery; the heat developed inside a cask of tobacco during the curing process determines to a great extent the quality of the product; and many other examples of widely differing kinds could be cited.

In order to afford an accurate and convenient means for determining moderate temperatures at such remote points, an instrument called a potentiometer has been devised. This instrument depends for its operation on the familiar thermo-couple—a combination of two dissimilar metals, such as copper and German silver, which has the property of developing a weak electric potential when the point of contact between the metals is heated. One of these couples is placed at the point at which the temperature measurement is to be made (frequently it is permanently built in place), with leads running to the surface where they are connected to the potentiometer when readings are wanted.

Portable and station or switchboard types of the new potentiometer are shown in the illustrations. Among the more important parts are a dial with two movable arms, controlled by a double knob in the center of the dial, and graduated in degrees Centigrade; a thermometer; and a galvanometer. To make a temperature reading the proper connections to the thermo-couple are made and then the shorter arm on the dial is adjusted to correspond with the temperature reading of the thermometer. A button is then pressed and if the galvanometer needle moves, the longer dial arm is moved to the right or the left, according to the movement of the galvanometer needle. The galvanometer button is pressed again, and the adjustment of the arm continued until there is no deflection of the needle. The temperature of the thermo-couple is then read off directly in degrees Centigrade.

The principle of this instrument is to balance the electromotive force produced by the thermo-couple with that produced by a second one at a known temperature. This second couple is contained within the potentiometer; it is located in contact with the thermometer bulb and is supplied with current from a small dry battery. Each arm of the dial is connected with a contact that slides over a length of resistance wire in series with the couple of unknown temperature, and the adjustment of the second arm is to find the point at which the drop in potential in the resistance wire is equal to that in the "cold" couple. At this point the galvanometer shows no deflection.



Switchboard type of instrument which measures temperatures by comparing known and unknown thermo-couples

Portable type of new temperature-measuring instrument which is used in many industrial processes

Converting the Car Into a Stationary Engine

EVERYBODY must by this time be familiar with the abstract fact that the engine of the runabout or touring car can be used for a lot of odd jobs around the farm or the suburban residence. It is perhaps not always clear, however, just how the transfer of power is to be effected; and in such event the device which we illustrate may help solve the problem.

This consists essentially of a truck-like framework, mounted on tiny wheels for easy moving about. It is rolled up to the rear wheels of the car, and the lever ends inserted beneath the axle. A vigorous downward push on these bars then elevates the wheels of the automobile from the floor and at the same time jams the shaft wheels of the little truck hard against the tires in a species of friction clutch. The three stages of this process are admirably shown in the accompanying illustrations.

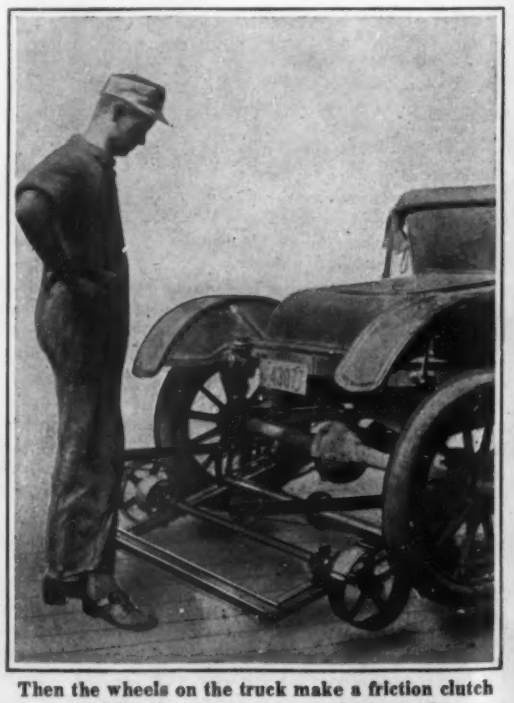
It will be noted that the shaft carries a third and smaller wheel designed to receive a belt. By this means the car engine can be made to run any piece of apparatus which is not actually beyond its power. When it is desired to transport this little helper, along with the car, to a distant job, it can be packed neatly onto the running-board.

The Current Supplement

THE current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2167, for July 14, offers an unusual variety of interesting and valuable matter. The paper on *Natural Measurement of Time* discusses the different kinds of years, their history and how they are derived. *The Impact Origin of the Moon's Craters* considers some features peculiar to lunar physiography and is illustrated by a number of photographs. *The Indian Silk Industry* contains much interesting information relating to silk culture and production in the far east. *The Art of Modern Taxidermy* tells how the specimens of the larger mammals, and the wonderfully natural groups to be seen in our larger museums are prepared, the models made and the skins mounted. It is illustrated by excellent photographs showing some of the work and methods of the National Museum, at Washington. The first two of a valuable series of lectures on *The Electrical Properties of Gases*, delivered by Sir J. J. Thomson before the Royal Institution, appears in this issue. The old-fashioned revolver has become obsolete, and its place has been taken by ingenious automatic pistols, which are being used exclusively as a small arm in the armies of Europe. The article on *Automatic Pistols* reviews the principal varieties that have been introduced in recent years, with some description of their mechanism. The article is illustrated by a large number of cuts. *The Conservation of Garments in Laundering* gives much valuable information about the processes employed in so-called steam laundries, and the efforts that are being made to produce satisfactory results. There are a number of other valuable articles, including *Melting Zirconia and Production of Ware Therefrom*, *Dielectrics in Electrostatic Fields*, *Osmotic Pressure* and *Physico-chemical Consideration of Benzol Recovery from Coal Gas.*

This device jacks up the wheels and converts the car into a stationary engine

Inserting the lever ends under the axle, a strong push lifts the car's wheels from the ground



Then the wheels on the truck make a friction clutch with the tires and we are ready for work

German Military Aeroplanes

(Concluded from page 29)

in front, these machines, used either as single-seaters or double-seaters, played great havoc with the Allies' scouts and warplanes.

In spite of the constant pooh-poohing of the Fokker's capabilities in the British parliament, there is no doubt that they proved a serious thorn in the flesh of England and France, who notwithstanding their boasts, required some length of time before they were able to develop a model capable of coping with them. Hardly a week passed without the chronicling of some German pilot shooting down his fourteenth or fifteenth enemy aeroplane. Undoubtedly the majority of these warhawks were using Fokkers. Their tactics, which have often been described, may be worth repeating. The Fokker pilot, who seldom ventures over hostile territory, climbs to a great altitude over his own lines perhaps as high as 12,000 feet. This, on a cloudless day, gives him an enormous field of observation. Upon spying an enemy aeroplane he is enabled to swoop down at a great speed, and when within range of his adversary, to fire directly in front and below, which he is enabled to do by the steel plates fitted on the deflector propeller, which turn aside the small percentage of bullets striking it. Another method is to dive under an opponent's tail, coming up the other side, and firing from behind in such a manner that the quarry cannot return the compliment without endangering his tail and rudder. The whole proceeding, as well as the machine itself, is remarkable for its simplicity; though, no doubt, it calls for exceptional capabilities on the part of the pilot. Like all fast monoplanes and small biplanes of the "lifting tail" class, the Fokker is extremely difficult to fly and learn on, and is said by some not to possess a very good fore and aft control. It may be remarked that a Fokker machine of an earlier type was the first German-built aeroplane to loop the loop.

To meet the menace of the German Fokker machines, which was very serious during the earlier months of 1916, the Entente aeronautical constructors introduced high speed machines capable of climbing at a high rate of speed, notable among them being the Nieuport *avion de chasse*, a diminutive single-seater biplane. Again the Germans responded with new machines, when they found their Fokkers unable to combat successfully the Nieuports and other machines introduced by the British and French designers. Among their new machines is the Albatros biplane which is, like the Nieuport, a single seated biplane with a short wing spread.

To give the enemy his just due, it must be admitted that the German constructors and designers have been able thus far to keep pace with the British and French aircraft. At the present moment the Allies have introduced still faster machines —machines which climb at the astounding rate of 10,000 feet in the first 10 minutes —and it is still too soon to learn what Germany has to offer by way of answer. The French have introduced the Spad biplane, designed by M. Louis Bleriot, which is capable of a speed well over 130 miles an hour and is equipped with two fixed machine guns firing through the propeller by means of the mechanism pictured in a recent issue of the SCIENTIFIC AMERICAN. The British, too, have not been slow in developing new machines to combat the German efforts.

In their anxiety to meet the efforts of their opponents the Germans appear to be using their existing designs in general and merely reducing still further the head resistance by little refinements, as well as placing more powerful engines in their planes. Perhaps this assumption is verified by the reports from the front to the effect that numerous German aeroplanes have of late been seen to break in two in midair, which would indicate that their construction is over-strained by engines of excessive weight. Of course, this is one way of getting more speed and climbing capacity out of a given machine, but obviously it is a poor and reckless one.

HOW do you know it's Bay Rum?

"Your Nose Knows"

by the *fragrance!* And everyone knows, by the fragrance, that you have been to the barber's—just as everyone knows, instantly, by its *fragrance*, when you are smoking a really pure tobacco. No one questions the value of *fragrant* things, for *pure fragrance* is proof positive of quality. "Your Nose Knows."

Such a proof of quality you will find in

Tuxedo

The Perfect Tobacco for Pipe and Cigarette

Its *pure fragrance* is the pure fragrance of Nature. The rich, ripe Burley leaves of which Tuxedo is blended are the sunshine tips of the best plants grown in the Blue Grass region of Old Kentucky. For *pure tobacco fragrance* Tuxedo is beyond compare. "Your Nose Knows."

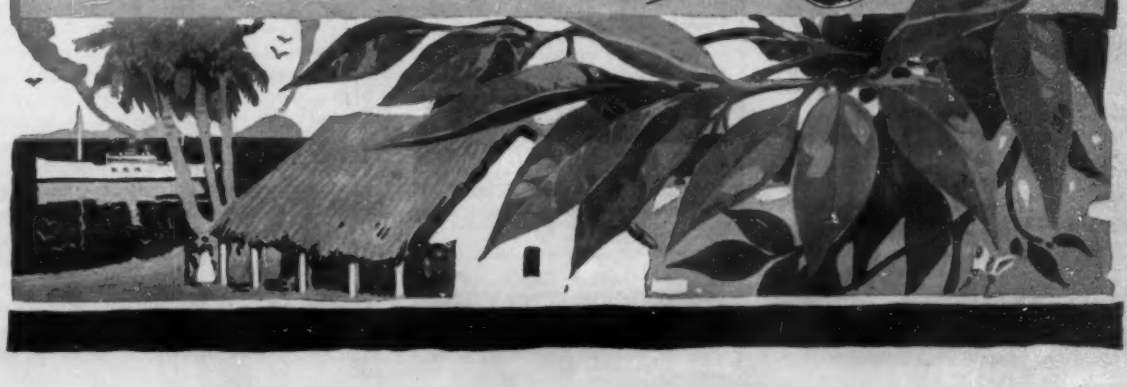
Try this Test:—Rub a little Tuxedo briskly in the palm of your hand to bring out its full aroma. Then smell it deep—its delicious, *pure fragrance* will convince you. Try tnis test with any other tobacco and we will let Tuxedo stand or fall on your judgment—

"Your Nose Knows"

Guaranteed by

The American Tobacco Co.

INCORPORATED



But what is "medium" oil?

"A quart of medium oil, please!"

What *is* "light" oil?
What *is* "heavy" oil?

EVERY motorist should know this once and for all: "Light," "medium" and "heavy," when applied to oils are extremely uncertain terms.

They are no more definite than "mild," "medium" and "strong" when applied to tobacco.

We have never yet found two "light," "medium" or "heavy" oils of different manufacture which tested alike.

Of nine different "medium" oils we recently purchased from different dealers no two were alike either in specific gravity or in viscosity.

So if the motorist always asks for "medium" oil, the resulting lubrication will plainly be uneven.

For the one time when he secures a proper piston-ring seal there are many times when the piston-ring seal will be poor. The fuel charge and power will then waste past the rings. And it is quite possible that this motorist should *never* have asked for "medium" oil in the first place.

The thorough piston-ring seal supplied by the grade of Gargoyle Mobiloils specified for *your* car never varies. The power and economy discovered in the first gallon will be continued as long as you use the oil.

Every quart of Gargoyle Mobiloil "A" is exactly like every other quart of "A." "B" is always "B," "E" always "E," "Arctic" always "Arctic."

The following test rarely fails to show surprising results in favor of scientific lubrication:

An Economical Demonstration

It will probably cost you less than $1 to fill your reservoir with the grade of Gargoyle Mobiloils specified for your car. Your dealer has it, or can promptly secure it for you.

Ask him to empty your reservoir of its present oil and fill it with the correct grade of Gargoyle Mobiloils. You can then judge for yourself, the results in—gasoline economy and reduced oil consumption, to say nothing of reduced carbon deposit and greater power.

Write for new 56-page booklet containing complete discussion of your lubrication problems, list of troubles with remedies, and complete Charts of Recommendations for Automobiles, Motorcycles, Tractors and Marine Engines.

GARGOYLE

Mobiloils

A grade for each type of motor

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If your dealer has not the grade specified for your car, he can easily secure it for you.

VACUUM OIL COMPANY
Rochester, N. Y., U. S. A.

Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.

Domestic Branches:

Detroit	Chicago	Minneapolis
Boston	Philadelphia	Pittsburgh
New York	Indianapolis	Des Moines
Kansas City, Kan.		

Correct Automobile Lubrication

Explanation:—The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil "Arctic"

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A." "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

This Chart is compiled by the Vacuum Oil Co.'s Board of Engineers, and represents our professional advice on Correct Automobile Lubrication.

Model of CARS	1917 Summer	1917 Winter	1916 Summer	1916 Winter	1915 Summer	1915 Winter	1914 Summer	1914 Winter	1913 Summer	1913 Winter
Abbott-Detroit	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (8 cyl)			A	A	A	A				
Allen	A	Arc	A	Arc	A	Arc	A	A	A	A
" (Mod. 33-34-35)					A	Arc				
Apperson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Auburn (4 cyl)			A	Arc	A	Arc	A	A	A	A
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Autocar (2 cyl)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc		
" (8 cyl)			A	A						
Buick	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
Cadillac							Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	Arc	Arc				
Case	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Chalmers			Arc	Arc	Arc	Arc	A	A	Arc	Arc
" (Mod. 6-40)			A	Arc						
" (Mod. 6-36)	A	A	A	A						
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Cole			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	A	A				
Cunningham					Arc	Arc	Arc	Arc	A	A
" (8 cyl)	A	A	A	A						
Daniels (8 cyl)	A	A	A	A						
Dart	A	Arc	A	Arc	Arc	Arc	A	A	A	Arc
" (Mod. C)	A	Arc	A	Arc	A	Arc	A	A		
Detroit	Arc	Arc	Arc	Arc	Arc	Arc	A	A	A	Arc
" (8 cyl)					Arc	Arc				
Dodge	A	Arc	A	Arc	E	E				
Dort	A	Arc	A	Arc	A	Arc				
Empire (4 cyl)	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc						
Federal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Flint	E	A	E	A	E	A	E	A	E	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	Arc
Grant	A	A	A	Arc	Arc	Arc	Arc	Arc		
Hal-Twelve	A	A	A	A						
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Hollier (8 cyl)			A	A	A	A				
Hudson			Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (Super Six)	A	Arc	A	A						
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Jeffery	A	Arc	A	Arc	A	Arc	A	A		
" (Chesterfield)			A	A	A	A				
" Com'l	A	Arc	A	Arc	A	Arc	Arc	Arc	Arc	Arc
Jordan	Arc	Arc								
Kearns			E	E	E	E				
" Com'l	A	Arc	A	Arc	A	Arc				
Kelly Springfield	A	A	A	A	A	A	A	A	Arc	Arc
King					A	Arc	A	A	A	E
" (8 cyl)	A	A	A	A	Arc	Arc				
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" Com'l	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Mod. 45)			A	A	A	A	A	A		
" (12 cyl)	A	A								
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Liberty (Detroit)	Arc	Arc								
Liberty (Detroit)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty (Detroit)										
Leopard Sport	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. M)	A	Arc	A	Arc						
" (Mod. M 6)	A	Arc								
Locomobile	E	E	E	E	E	E	E	E	Arc	Arc
McFarlan	A	Arc	A	A	A	Arc	A	A	A	Arc
Marion Handley	Arc	Arc								
" (Mod 6-40)	A	Arc								
Marmon	A	A	A	A	A	Arc	A	Arc	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	Arc	A	Arc	A	Arc
" (22-70)					Arc	Arc				
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Mitchell (8 cyl)			A	A						
Moline									A	Arc
" Knight	A	A	A	A	A	A	A	A		
Moon (4 cyl)					Arc	Arc	A	Arc	Arc	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Murray (8 cyl)	A	A								
National	Arc	Arc	A	Arc	A	Arc	A	A	A	A
" (12 cyl)	A	A	A	A						
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	A
" (8 cyl)			A	A						
Oldsmobile			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A						
Oakland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Owen Magnetic	A	Arc	A	Arc	A	Arc				
Packard					A	Arc	A	Arc	Arc	Arc
(12 cyl)	A	A	A	A						
" Com'l	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Paige					A	Arc	A	A	A	E
" (6-46)	Arc	Arc	Arc	Arc	Arc	Arc				
" (6-51 & 38)	A	Arc	A	Arc	A	Arc				
Pathfinder	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
" (12 cyl)	A	A	A	A						
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6 cyl)	A	A	A	A						
Pierce Arrow	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
Pullman	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl)	A	A	A	A	Arc	Arc				
Renault			A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Richmond	Arc	Arc	Arc	Arc	A	A	A	Arc	Arc	Arc
Riker	E	E								
Saxon	E	E	E	E	E	E	E	E		
Scripps-Booth (air)							A	A		
" (water)	A	Arc	A	Arc	E	E				
" (8 cyl)	A	A	A	A						
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Simplex	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
Stearns-Knight	A	A	B	A	B	A	B	A	A	A
" (8 cyl)	A	A	B	A						
Studebaker	A	Arc	A	Arc	Arc	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	Arc	Arc
Velie (4 cyl)					A	Arc	A	Arc	A	Arc
" (6 cyl)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Wentworth	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (16 valve)	A	A								
Willys-Knight	A	A	B	A	B	A	A	A		
Willys Six	Arc	Arc								
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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Exception: For *winter lubrication* of pleasure cars, use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.

A Two-Stacker Gold Dredge

(*Concluded from page 21*)

course, to the necessity for crushing ore and chemically treating it. This is not necessary on the gold dredge.

Another photograph gives a good idea of the tremendous size of the dredge. It was taken from one stacker. To the end of the other stacker, in a direct line, is 416 feet and practically as much to the end of the digging ladder at the right. In the distance can be seen Yuba No. 15 at work.

We show likewise a bow view of this dredge, the bow gantry in the foreground and the two stackers with their tremendous sweep at the stern. This gold dredge cost something over $600,000 to put in operating condition. It is now proposed to add a small stacker directly at the stern to deposit a thin layer of a heavy cobble stone at the bottom of the channel, so as to prevent the slightest possible danger of the spring floods sweeping soft silt from the bottom of the channel down stream to clog the lower river.

Strategic Moves of the War, July 5th, 1917

(*Concluded from page 26*)

day come reports of attacks at various points on the fronts named and, while some small successes have been obtained, as a whole they have been failures. Some believe the Germans intend a great offensive against the French; but that now seems impossible since no more troops can come from the Russian front. It may be that the German efforts are only to forestall a movement along the Aillette lines against Laon from the newly won positions along the Chemin des Dames on the Craonne plateau. A French advance along the Aillette lines would put a wedge into the Hindenburg lines, leaving both wings in the air and at the same time cutting in toward the German lines of retreat in case of disaster. This advance would be especially threatening if the German reserves have to be taken away to hold the British back farther north. These views seem to be borne out by the constant German assaults around Cerny on the Craonne plateau and on the front at Verdun between Avocourt Wood and Dead Man's Hill, all of which have been repulsed. No advance in depth has been accomplished and no important point has been captured.

Recent events in the Italian theaters of war show nothing of importance beyond a check to the Italian forces in the Trentino and some heavy artillery actions on the Julian front. Now that Russia is again in the fray, it is hardly probable that Austria can keep on these fronts enough men to make serious advances. In fact, if under present conditions she can hold her own for any length of time against Italy, it will be all that can be expected; for it must be long ago that she reached her limit in man power and in material resources.

Events have moved rapidly in Greece. King Constantine is an exile in Switzerland after an exhibition of duplicity and blunders seldom equalled by any ruler. Venezelos, the one statesman who has sufficient breadth of view and knowledge of conditions to stand firm, is once more in power. The Greek government has broken off diplomatic relations with the Central Allies so that a practical alliance with the Entente and a condition of war with the Teutonic powers now exist. Greece can be of little practical assistance to her allies for some time to come, as enormous stores of her artillery, rifles and ammunition were surrendered by King Constantine to the Bulgars. But present conditions remove all fears of an attack from the rear on the troops operating in Macedonia and in many other ways that country can be of value to the strategic plans of the Entente. When supplied with the necessary arms, equipment and guns, no doubt 300,000 fighting men can be put in the first line. It will take time to reorganise and rebuild, but, once finished, the Greek army can render a good account of itself in the field.

A Sea Fight In the Adriatic

(*Concluded from page 25*)

we headed for Miramar. They did not come nearer; but the Lord knows they were near enough, and by rights they should have sent us to the bottom the first three shots. Even had they steamed directly up to us, they could have got us by the scruff of the neck in five minutes, for we could make only ten knots to their 25. One fast torpedo boat, risking what was a few hours ago their own mine field, and, of course, they knew nothing to the contrary, got the No. 10 and our launch in line and gave us all attention in the manner of a pot hunter trying to rake us. I had just taken my moving picture camera out of its case and set it on the tripod when a shell struck three feet from the launch, raising a big geyser. The column of water descending douched us and stopped our motor. I had to dry off the sparking plugs while the engineer got busy cranking. Happily the motor sprung right on again, and I got back to the camera and commenced cranking. I tried to keep the No. 10 and the "San Marco" in the view finder in case they should get hit, and endeavored to get the spouting of the shells. I got about one hundred feet of it, but it is a tame illustration of all the excitement of a race between life and death. The Italians with their speed having passed us now swung around again and edged us off from Miramar, so we held to the west of it for our shore batteries. All this time we kept wondering why the next shell didn't strike one of us. Then we saw one of our submarines just diving to the periscope. By this time we came nearly within range of our shore batteries, and one of them began to bark at the Italians, but at such range, and in the fog, they must have just tried to scare them, for we couldn't even see the shells hitting the water. However, we escaped "by the skin of our teeth."

As the fog had lifted a little, around noon, and we could see the houses on shore, evidently the lookouts had reported our presence and the Italians had left Grado to tackle us. The obscurity of the fog, the strange looking barge, the "San Marco," the proximity of the mine fields, all this had rendered the Italians so cautious that they were satisfied to run parallel with us and give us their broadsides. The last we saw of them was when they swung more and more round towards their own coast, and were again lost in the fog. They were the same four vessels that had bombarded us the day before, when I flew with Lieut. D—— in an hydroplane over Grado.

As the piers of Triest loomed up before us we saw them black with people. Everyone had heard the cannonading at sea, and expecting a big naval battle, had rushed to the piers to see what they couldn't see. There was much cheering and congratulations when they heard of our narrow escape.

A Plague of Mice

THE wheat harvest in Australia for the present season of 1916–17 is the largest on record. One result of such favorable conditions is that the European field mice in this colony have increased to such an extent that they are doing enormous damage throughout the states of New South Wales, Victoria and South Australia. Their attacks upon the wheat lying stacked in bags awaiting shipment alone threaten loss to the extent of millions of dollars. To save this wheat all the stacks are being surrounded with mouse-proof fences of galvanized iron with openings left every 16 feet, in which are placed kerosene tins, sunk in the ground with 6 inches of water in the bottom. The mice already in the stacks when this miniature fortification is put in place must go out for water, and when they try to do so they fall into the tins. At one country railroad station nearly ten thousand mice were caught in this way in a single night. The experiment of driving the pests out of a stack by using the fumes of carbon bisulfide has also been tried with some success. In some districts the mice are dying in large numbers from skin diseases.

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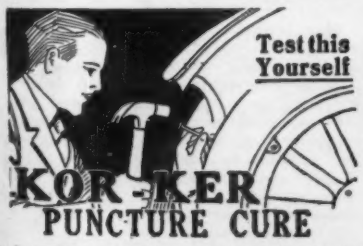

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Radium for Everybody

(Concluded from page 31)

Under individual ownership, a large share of the world's meager supply of radium must lie idle most of the time.

The remedy, of course, lies in a radium institute or clearing house of some sort. What sort, where, and of what scope, territorially and otherwise, are questions to be answered by the makers, in the making. One set of answers is right now being given by the Physicians' Radium Association of Chicago. This is a voluntary and coöperative body organized by a number of the Windy City practitioners. In brief, the scheme is this: Funds will be borrowed from the banks to purchase radium, which will be mortgaged to secure the loan. A rental will be charged for the use of the radium just sufficient to pay the interest on the indebtedness and provide a moderate sinking fund. Eventually the radium becomes the property of the Association, free and clear, and then can be applied without charge in all charitable institutions, as well as made available for the use of physicians. The idea is simply to provide a storehouse of radium at Chicago upon which the whole medical fraternity within reasonable distance can draw whenever a case needing the material comes up, afterward returning it promptly to be sent out on another errand of mercy. The success of the entire plan, of course, rests upon the fact that radium is used without being used up.

It is to be emphasized that this is not an organization for profit. The charge made for the use of the radium is only enough to cover the items mentioned above, and the cost of the supervision which the insurance company naturally requires. This charge, for the first year of the Association's life, will be five cents per milligram hour. It is hoped, as the Association's indebtedness is reduced from time to time, to make corresponding reductions in the rental figure; and especially it is the aim to be able after the second year to place a certain amount at the permanent disposal of deserving charities. Even before this time is reached, such loans may be secured at any moment when the Association's entire radium supply is not in use. In all cases the Association will be prepared to furnish without charge all paraphernalia necessary for the proper application of the radium, and to give the renting physician the benefit of expert advice as to proper technique, dosage, etc.

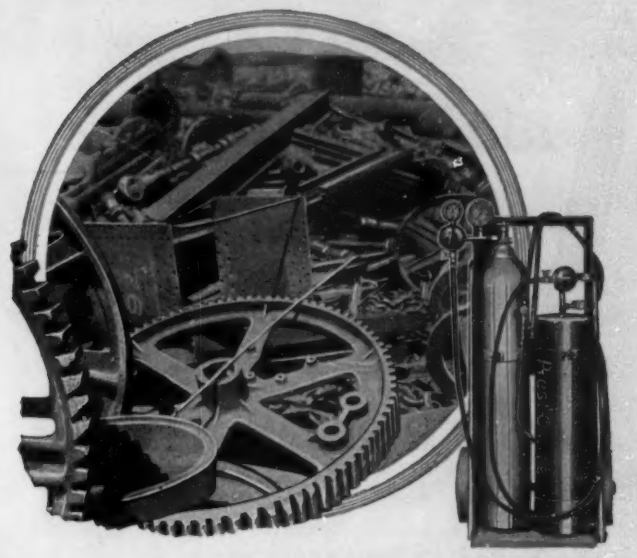
The initial effort of the Association is represented by one tube of 50 milligrams, two of 25 milligrams each, and a surface applicator containing five milligrams of the precious mineral. When the rentals have paid for this supply more will be bought, until the Association has a capital of half a million dollars tied up in radium This it is anticipated will be sufficient to meet the demands which are likely to be made upon the Association.

A more praiseworthy enterprise than this one it would be hard to imagine; and it seems that banking and medical coöperation should be able to bring about such a foundation in all our larger centers.

Fish Refrigerating Plants for Newfoundland

ARRANGEMENTS have been completed by a fish corporation for the erection of a number of cold-storage plants at various places on the coast of Newfoundland. The principal plant will be erected in the city of St. Johns and will occupy ground space of about 245 feet by 90 feet. The plan calls for a six-story building, but only three stories will be erected at present. The basement will be of concrete, and above this the walls will be constructed of local brick, of which about 725,000 will be required. The lower flat will contain the freezing apparatus, having a refrigerating capacity of 150 tons, where fresh fish will be frozen in about two hours. The ammonia plant for making artificial ice for preserving bait and for use on cars and steamers will be on the same floor. The second and third stories will be used for storage purposes. The entire building will have a capacity of about 10,000,000 pounds of frozen fish.

Oxy-Acetylene Welding and Cutting



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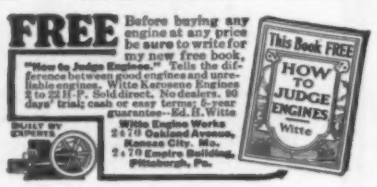

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How Submarines Feel Their Way When Submerged

(Concluded from page 25)

hour, by means of a small hand which points to a series of figures on the extreme outer edge of the dial as shown.

The instrument in the navigating station consists of a small portable panel which may be taken to the bridge when the vessel is awash. It carries, above, a revolution indicator for each engine in the center, a log dial to give the total distance traveled, the distance traveled since last setting and the average revolutions of both engines, and, at the bottom, a stop clock similar to that in the engine room. All three of these dials are operated by the vacuum or suction in the connecting pipe lines between the pumps. While the hands of the revolution indicator, by means of bellows which contract under vacuum and expand under pressure from the two pumps, are made to move to right or left to show in what direction the shaft is turning, the piping of the stop clock and log is so arranged that these are operated from one pump. This is because one engine may be running astern and the other ahead, or one may be at rest, thus mutually tending to release the pressure or vacuum. The log dial has two hands, one of which indicates the total distance traveled and the other the distance traveled since the last setting. The latter, used to determine the distance made on any course, may be set to zero just before submerging, and will then show the distance covered while proceeding beneath the surface. As the bottom becomes fouled, this hand may be adjusted to indicate the speed of the vessel.

A Waste Product of the Rice Field Now Used in the Sugar Refinery

IN the sugar refining process of today, raw sugar is put through large cylinders filled with bone black. The latter consists of pure carbon, suspended upon an infinitesimally thin skeleton of lime phosphates. The sugar after passing through the cylinders is found to have been bleached white, all the coloring matter having been retained by the carbon of the bone black. In the effort to make it possible for the Louisiana sugar planter to do his own refining, under his own sugar-house roof, experimenters have tried out many vegetable substances, endeavoring to char them into the carbon state and at the same time give them the necessary mineral backbone, analogous to the phosphates of the bone black.

Recently such a carboniferous substance was presented to the State Experiment Station, tested, and found satisfactory. It had as its striking note a high content of silica, and it was found to decolorize the sugar more rapidly and more powerfully than did the bone black with its lime basis. This silicious character suggested strongly that rice hulls would serve the same purpose, since they too consist largely of silica. They were tried and found so satisfactory that the discovery has been submitted to the Department of Agriculture in Washington, with the understanding that the State chemists are willing to have their discovery made public property.

Heretofore the very decolorizing properties of the rice hulls have prevented their use as feed for cattle, so that they have been a total waste. The proposition of using them as a sugar bleach will at once eliminate this waste and relieve the sugar planter of a heavy item of expense. The method of preparation is simplicity itself. The leaves and hulls are separated from the straw, charred, and boiled with a 5 to 10 per cent solution of caustic soda—and that is all there is to it.

Coal Resources of Switzerland

THE recent great shortage of coal in Switzerland due to war conditions has awakened interest in the project of exploiting the coal deposits of that country, especially those of the Bernese Jura Mountains. According to a consular report from Berne, a coöperative society has been formed, with a capital of 800,000 francs, and drilling will begin at once.

New Books, Etc.

GRANDES VOÛTES. Par Paul Séjourné, Ingeniéur Conseil. Paris, France. 4to, 6 vols., 1732 pp., 334 photographic, 896 other illustrations. Bourges, 1917. Tardy-Pigelet, Publisher. Price, 250 francs.

This monumental work on "Great Arches," is a most elaborately gotten-up work. The typography and the cuts are of a character unequaled in American technical literature, but possibly not uncommon in Europe, where scientific works can be sold at much higher prices than in this country. To those American engineers who make a practice of designing reinforced-concrete bridges it is well worth the money; for the illustrations of over 200 important and generally highly-aesthetic structures are an inspiration. To a bridge engineer who reads French the tabulated data would be invaluable, for they are by far the most complete ever compiled. This book should be made available to the engineering profession of America by having it on the shelves of the public libraries in all large cities where engineers congregate and in the libraries of all the prominent schools where structural engineering is taught. One does not need to be able to read it in order to profit greatly by its contents. We regret that our limited space does not permit of giving it a thorough review; for we feel that, if it be widely and systematically used by American bridge designers, great and striking improvements will soon be effected in the future reinforced-concrete arch-bridges of this country.

CRIMINAL SOCIOLOGY. By Enrico Ferri, Professor of Criminal Law in the University of Rome. Translated by Joseph I. Kelly and John Lisle. Boston: Little, Brown and Company, 1917. 8vo.; 622 pp. Price, $5 net.

In this work another notable volume is added to the Modern Criminal Science Series; the author is perhaps the foremost living representative of the Italian school. The work is remarkable first of all for its comprehensiveness; for its recognition of the many angles of a complex problem, and for its success in correlating these theories, classifications and conceptions. Ferri recognizes but three factors in crime—the anthopological, the physical and the social; his rejection of free will eliminates the psychic factor from his field of investigation and undoubtedly weakens his argument to the extent that modification of some of his deductions may be necessary. Part I of the volume sketches the natural history of criminal man, cites fundamental objections to the data of anthropology, and offers a "natural classification" of criminals; Part II deals with methods of collecting statistics, with the influence of civilization, the periodic movement of crime, equivalents for punishment, and prevention and suppression; Part III takes up the positive theory of penal responsibility, the problem of penal justice with the denial of free will, and the conditions of criminality; Part IV presents practical reforms from various standpoints, examines the machinery of penal justice, and states the conclusions logically developed from the foregoing studies. Introductions by Charles A. Ellwood and Quincy A. Myers furnish excellent guides for an intelligent appreciation of the author and his work.

FINITE COLLINEATION GROUPS. With an Introduction to the Theory of Groups of Operators and Substitution Groups. By H. F. Blichfeldt, Professor of Mathematics in Leland Standford Junior University. Chicago: The University of Chicago Press, 1917. 8vo.; 205 pp. Price, $1.50 net.

Dealing with a subject whose literature has hitherto been largely of a fugitive nature, this text develops the fundamental properties of linear transformations and linear groups, furnishes an introduction to the theory of groups of operators and substitution groups, determines the groups in two variables by a modification of Klein's process, proceeds to ternary and quaternary groups, sketches the history of linear groups, and carries a convenient appendix in which needed theorems and definitions of an advanced nature are explicitly given.

ELEMENTS OF MILITARY SKETCHING AND MAP READING. By Capt. John B. Barnes, Fifth U. S. Infantry. New York: D. Van Nostrand Company, 1917. 16mo.; 106 pp.; illustrated. Price, 75 cents.

Capt. Barnes, in this little work now in a third and revised edition, furnishes beginners with a text on practical sketching for officers. At this time the work should find a hearty welcome, for simple in phraseology, it nevertheless provides full and exact information relating to scales, conventional signs, sketching implements, orientation, contours, road and position sketching, map reading and landscape sketching. There are numerous helpful diagrams, and several large folders elucidating time scales, scale for paces, and position sketches.

FLOOD-ABSORPTION IN TANKS. By S. K. Gurtu, M.A. Gwalior, India: Alijah Darbar Press, 1916. 8vo.; 82 pp.; with diagrams. Price, Rs. 3/8/-.

A third edition has given the author the opportunity of amplifying the work and extending its appeal. Engineers interested in the design of surplus works for reservoirs will find in it researches and methods of practical application that will be very useful. Formulas and tables are given for finding the absorption-capacity of reservoirs, which may result in considerable economy through the reduction in length of waste weirs.

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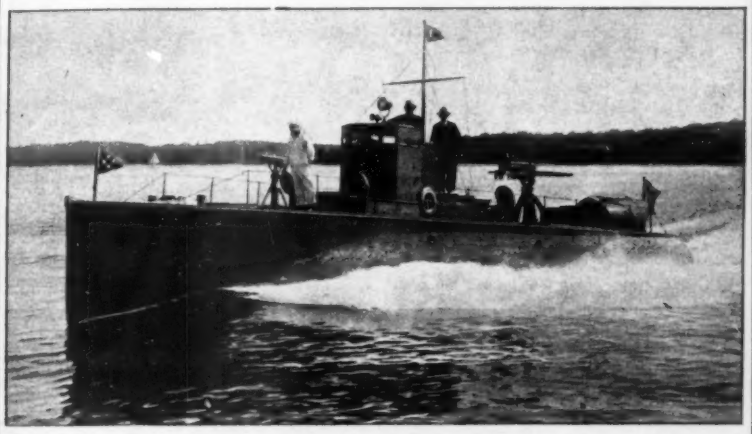

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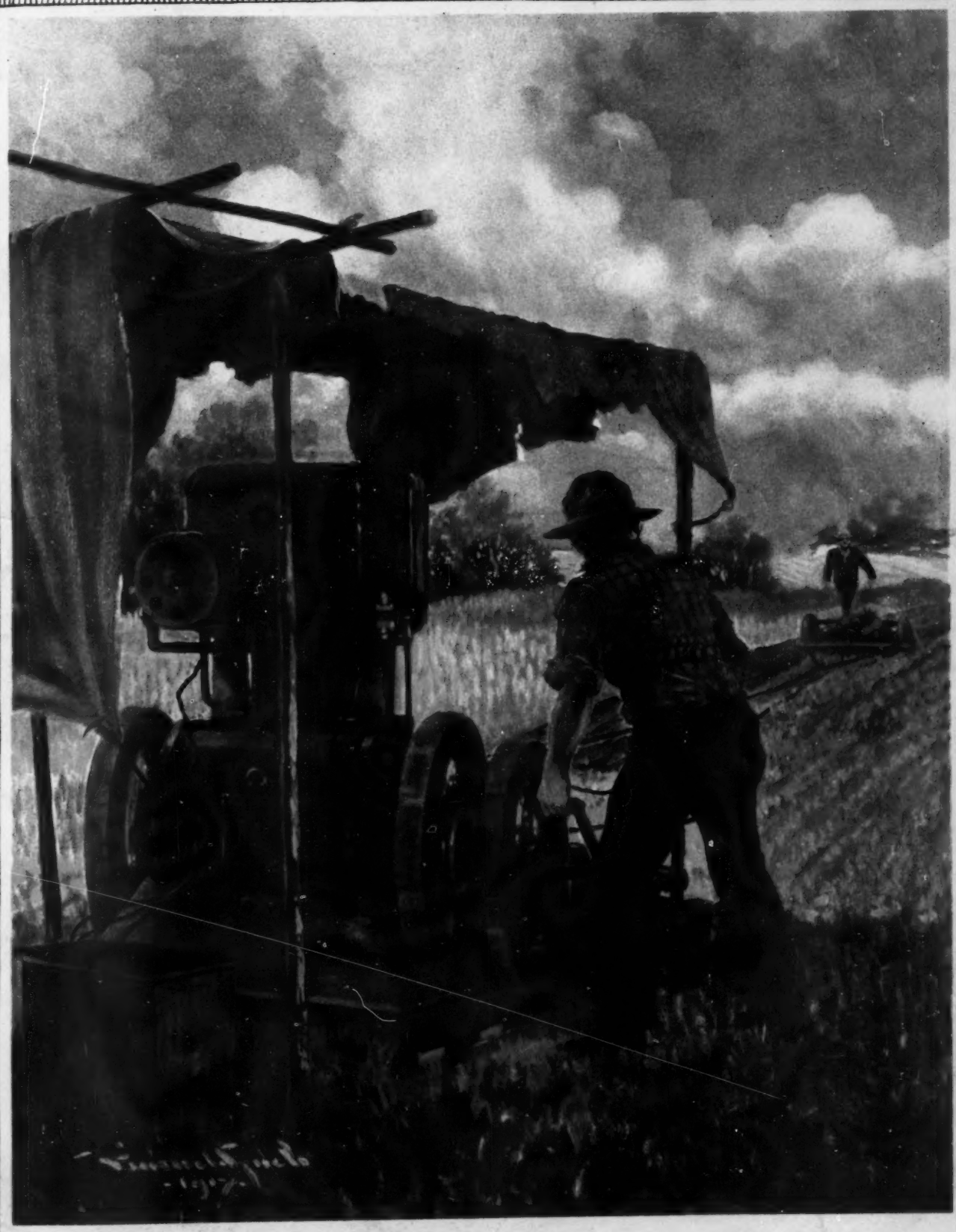

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